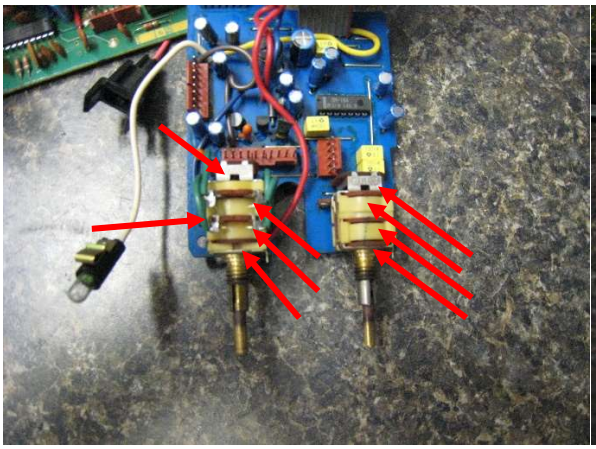
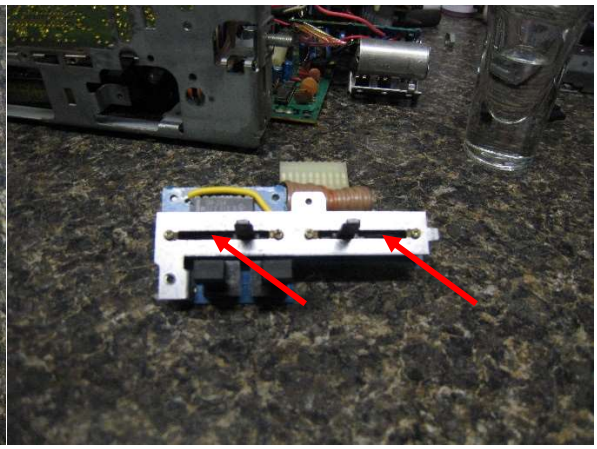




Gently remove the small circuit board that holds the bass and treble sliders from the radio. This board has a small metal tab at the top of it, which will require you to pull the logic board out of the face to provide clearance for you to remove. I honestly think this board was the first component installed when they built the radio! Once removed, clean and lubricate the slider controls by spraying cleaner/lubricant in the sliders and working them fully back and forth for a minute or two. The image above and to the right shows the removed board and where to spray (red arrows).

If you have made it this far, Congratulations! You're done with the refurbishment of the radio components. All you need to do is put it all back together again 😊.

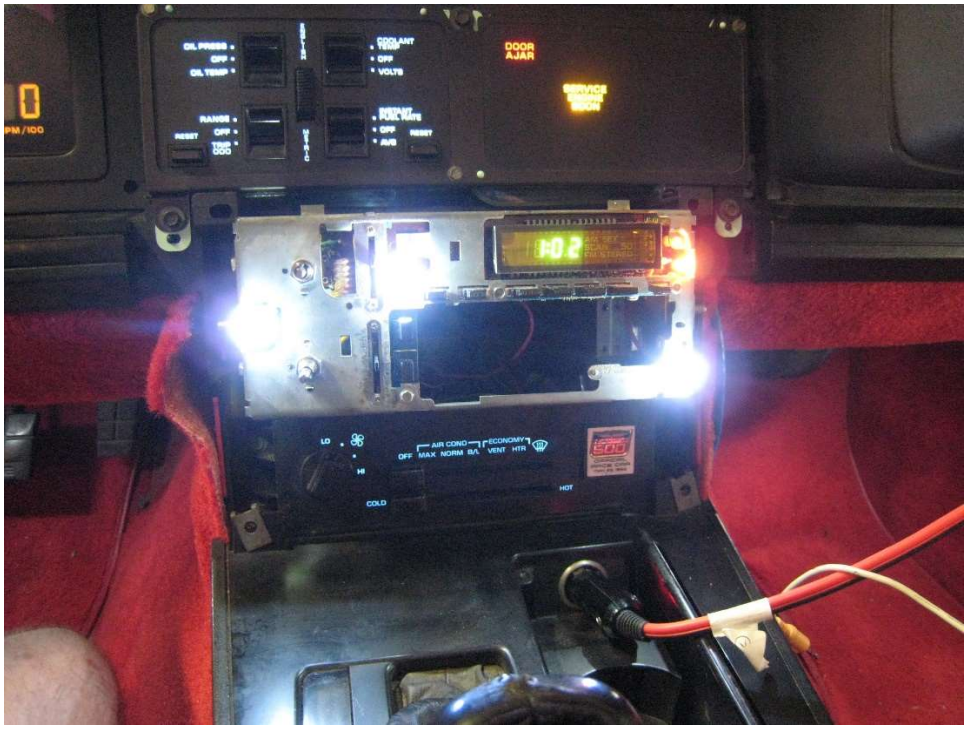
I tried to make the disassembly instructions specific enough to provide you with a photo record of how the unit is constructed so you can work backwards and know where each bolt is located and in what order to in which to fasten them.

It's cliché, but like every Haynes manual says, 'Re-assembly is the reverse order of these steps.'

Once you get the radio re-assembled without the faceplate and the cassette unit installed, you should re-attach it to the car wiring to check and see that it works.

While in this test, turn on your headlights and verify that all of the bulbs that illuminate the radio are working properly. If they are not, there will never be an easier time to replace them than now, so go ahead.

When I refurbished my radios, I replaced the three replaceable bulbs with LED lamps. LEDs will give you a much brighter illuminating light, lighting up the radio in a very nice blue at night. LED bulbs are polar and will only work when inserted one way in the socket, so it is best to get them fitted now before fully re-assembling the radio. In the below picture, you can see my radio wired up to check the LED bulbs.



The bulb in the upper right is soldered to the display board so I chose not to replace it. After assembly, I don't notice it looking any different. Below is a link to the LED bulbs I bought on Amazon as a reference for you if you want to go LED.

https://www.amazon.com/gp/product/B077TQGBJ3/ref=oh_aui_detailpage_o01_s00?ie=UTF8&psc=1

Touch the LED bulb to the socket but don't push it in. If the bulb lights, then go ahead and push it in, but if it does not, rotate the bulb 180° and try it.

The HVAC control panel and the small downward facing console illumination light in the rear-view mirror also uses these same bulbs, so you will use 6 of the ten pack in the above link.

If you are going to add the auxiliary input to the radio, I would suggest skipping to that section and doing it now. Just as with the radio, you are going to want to test your work and not having the cassette unit installed will give you more room.

1986-1989 Bose Stereo with Cassette Head Unit

Capacitance	Qty	Digi-Key Part #
3.3µF 50V	5	493-16322-ND
100µF 16V	7	493-15422-ND
10µF 50V	5	493-15440-ND
22µF 50V	1	493-15442-ND
1µF 50V	6	493-15438-ND
.33µF 50V	1	493-15448-ND
47µF 16V	2	493-15428-ND

470µF 16V*	6	193-15429-ND
10µF 16V	8	493-15421-ND
220µF 16V	1	493-15424-ND
22µF 16V	1	493-15423-ND
2200µF 16V	1	493-15425-ND
47µF 25V	5	493-16319-ND
47µF 10V	2	493-15419-ND

*This count includes 2 capacitors to replace the 470 µF-6.3V capacitors in the unit. Digi-Key did not have replacements for this size and voltage.

Refurbishing the Cassette Unit

Introduction

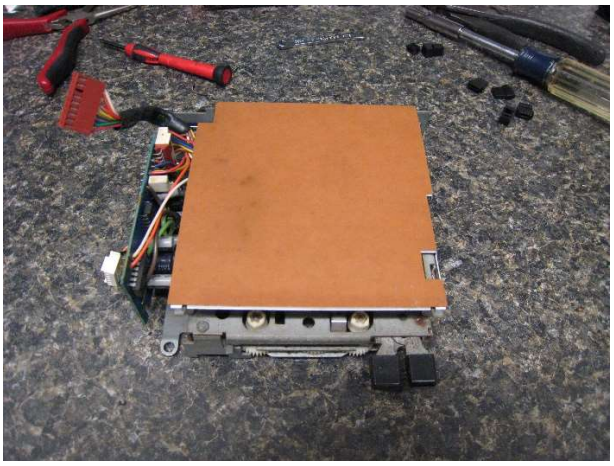
When these radios were made, cassettes were the mainstream way of making music portable. Gone were the days of the 8-track cartridge, but car CD units had not yet become affordable, and the one unit I remember seeing in a guys car required you to put the CD into a caddy unit, remember CD caddy units for drives???

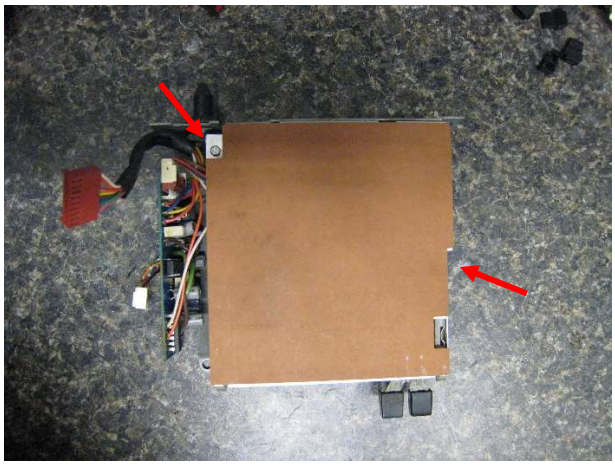
The unit in the radios was a pretty full featured unit for the time, including the ability to play both sides of the cassette via an auto-reverse mechanism, ability to handle Type II (Metal or Chromium Oxide tapes), and also the ability to detect the blank space between tracks, allowing you to skip to the end or get back to the beginning of the song currently being played.

As with any mechanical device, the drives in the radio wear with usage. The cassette mechanism endures the same types of wear and tear (capstan and pinch roller dirt and head magnetization) that every cassette deck does, and it also has to survive in a sometimes-humid environment. I have now taken apart several of these units and find it amazing just how different the condition of the internal components can be, in particular the amount of rust in the mechanism. If you are looking to buy a unit on eBay or privately, look and see if you can see any rust anywhere in the unit. Rust is an indicator of being in a humid environment. One of the units I have disassembled had bits of rust on the radio case and when I pulled the unit apart, the rust had totally disintegrated the pinch rollers, making the unit unusable. As with any project, starting with the best possible unit could make a difference.

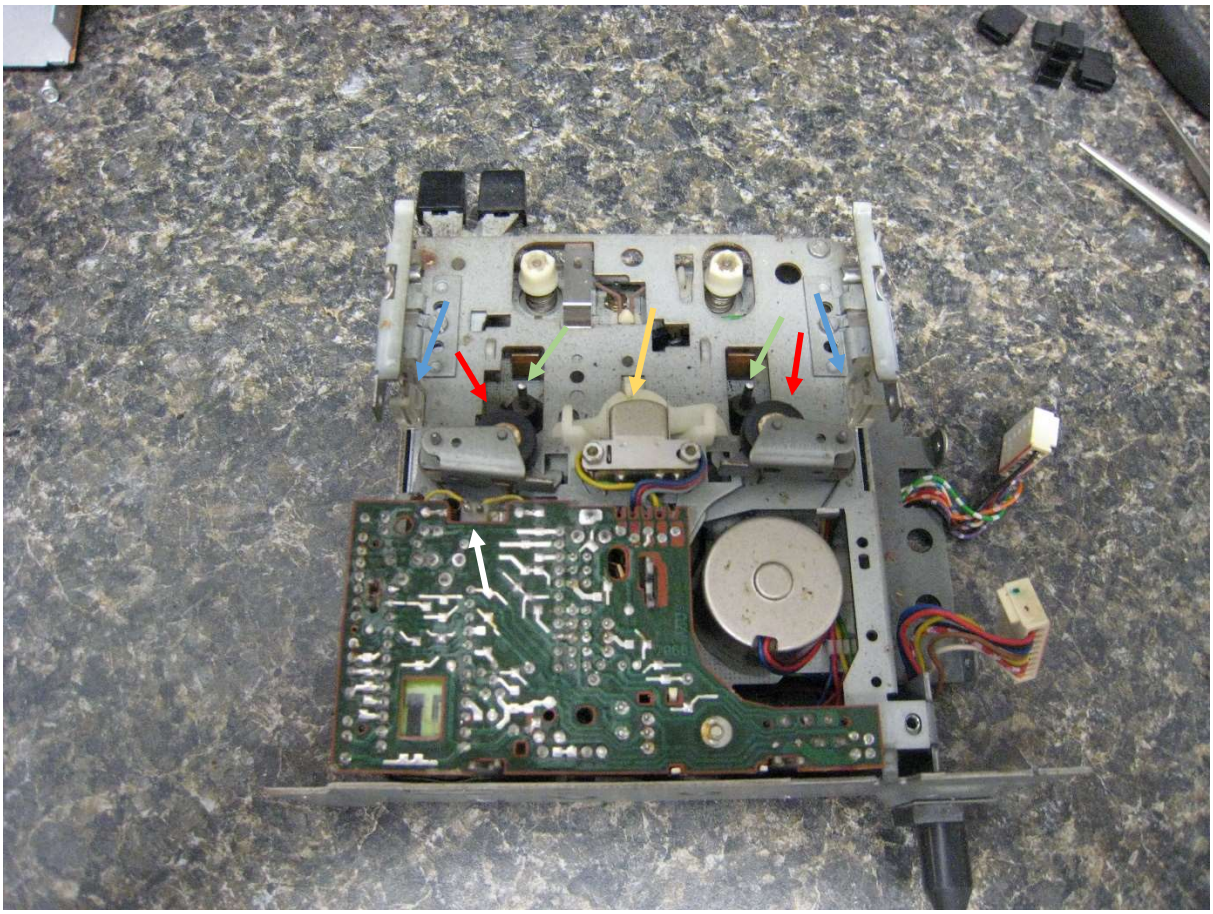
Refurbishing the Unit

I am going to assume you have already removed the cassette unit from the radio as part of the radio refurbishment procedure above so we will start with the unit as shown in the image on the left below.





Remove the two 3/16” bolts shown by the red arrows in the diagram above and to the right. Once the bolts are out, gently remove the cover and place it to the side. Once removed you unit show look like the image below.



At this point, you should inspect the unit to see if there are any showstoppers that will prevent the unit from ever working again.

First, inspect the pinch rollers (red arrows in image above). If you are not familiar with how a cassette deck works, the pinch rollers and capstan (green arrows in image above) are the drive mechanism.

When you insert a tape, the capstan drive raises up and inserts itself into one of the holes in the cassette. It then pinches the tape between the capstan and the pinch roller. As the capstan drive rotates, the tape is dragged along at a constant speed across the tape head. Without this pressure, the tape will not move, and with uneven pressure, the tape speed will not be constant. The measurement of this speed variation is called wow and flutter, and you can hear it when the music changes tone, speeds up or slows down.

Inspect the pinch rollers to make sure they move smoothly and are not wobbly. This is an area that I have seen as susceptible to moisture. The pinch roller pins and inner portion can rust, making then unusable. Unfortunately, if there is an issue here, it's a showstopper in my book and the unit is not worth saving.

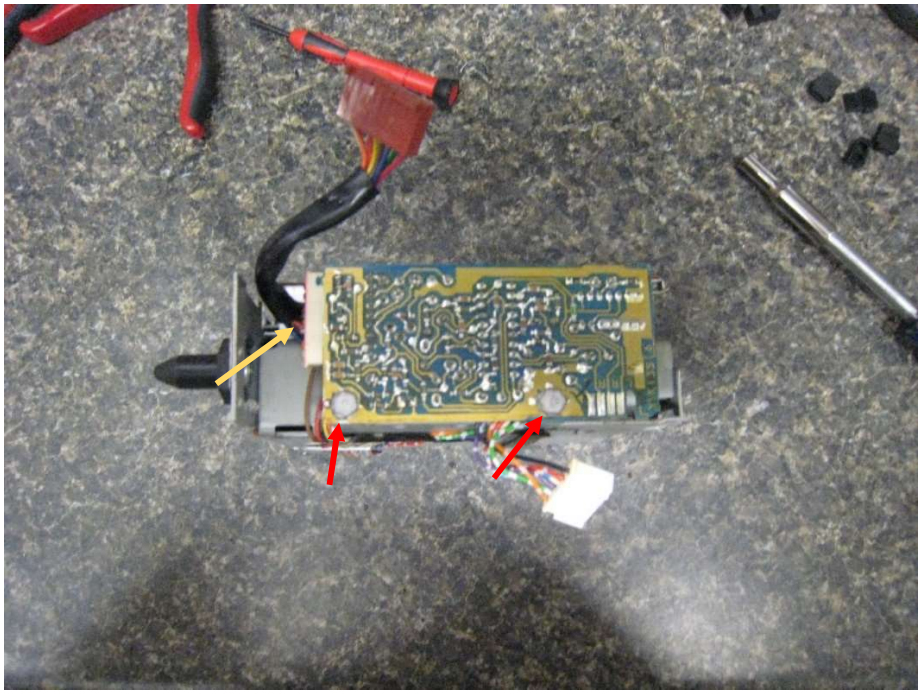
Inspect the tape head (gold arrow in image above) for signs of extreme wear which would include a vertical line (indicating the head is opening up) where the tape passes. Unless the unit was HEAVILY used, you probably are going to be fine with a good cleaning and de-magnetization.

Make sure the mechanism moves freely. To do this, you can either insert a cassette into the unit, or move the mechanism manually. I prefer to move the mechanism manually so I can watch the parts to see if any are jammed or hitting. To move the mechanism manually, push on the two clear plastic pieces illustrated by the blue arrows in the above image. When you push on them plastic pieces, the cassette drive mechanism should raise up and you can see the capstan drive engage the pinch roller. When fully engaged, you should hear a click. That click is the tape holder magnet touching the eject solenoid. When you insert a tape into the unit, the solenoid is energized and the mechanism is held in place for the tape to be played. Pressing the eject button shuts down the solenoid, and the springs on the mechanism retract the drive unit and eject the tape.

If you have trouble with tapes not being held in the unit (NOTE: This is not the common issue where upon insert the tape will switch sides twice and then eject), there could be an issue with the solenoid (white arrow in image above). I have successfully replaced this with a solenoid from a donor unit.

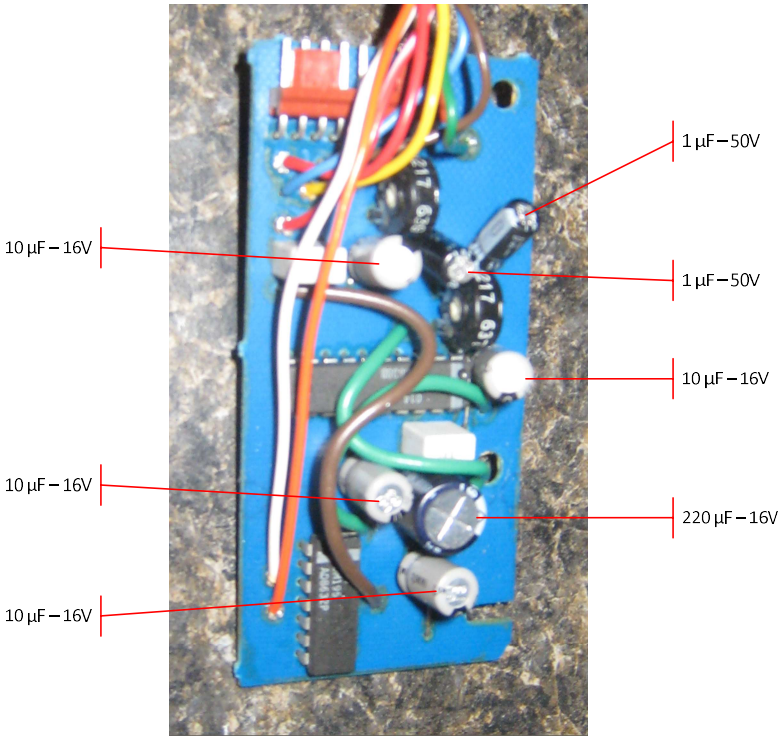
OK, so if everything looks good, or at least not too bad, it's time to start the actual refurbishment.

Refurbing the Circuit Board



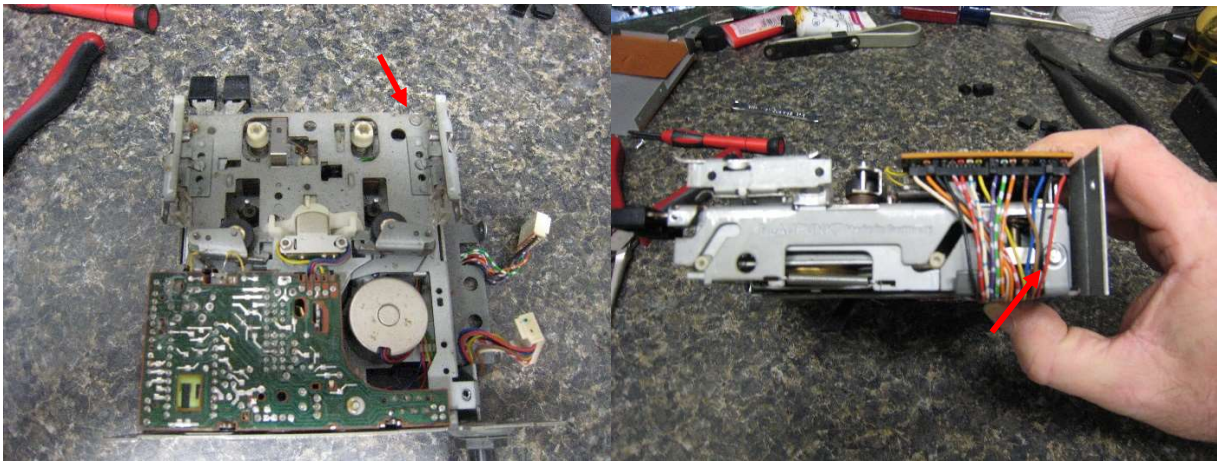
The red arrows in the image above and to the right point to the ¼" screws that affix the circuit board to the cassette unit. Remove these and pull the board away from the unit gently. With the board pulled away gently, remove the wire connector tucked behind the gold arrow to free the board completely.

Using the diagram below, replace the capacitors in the board.



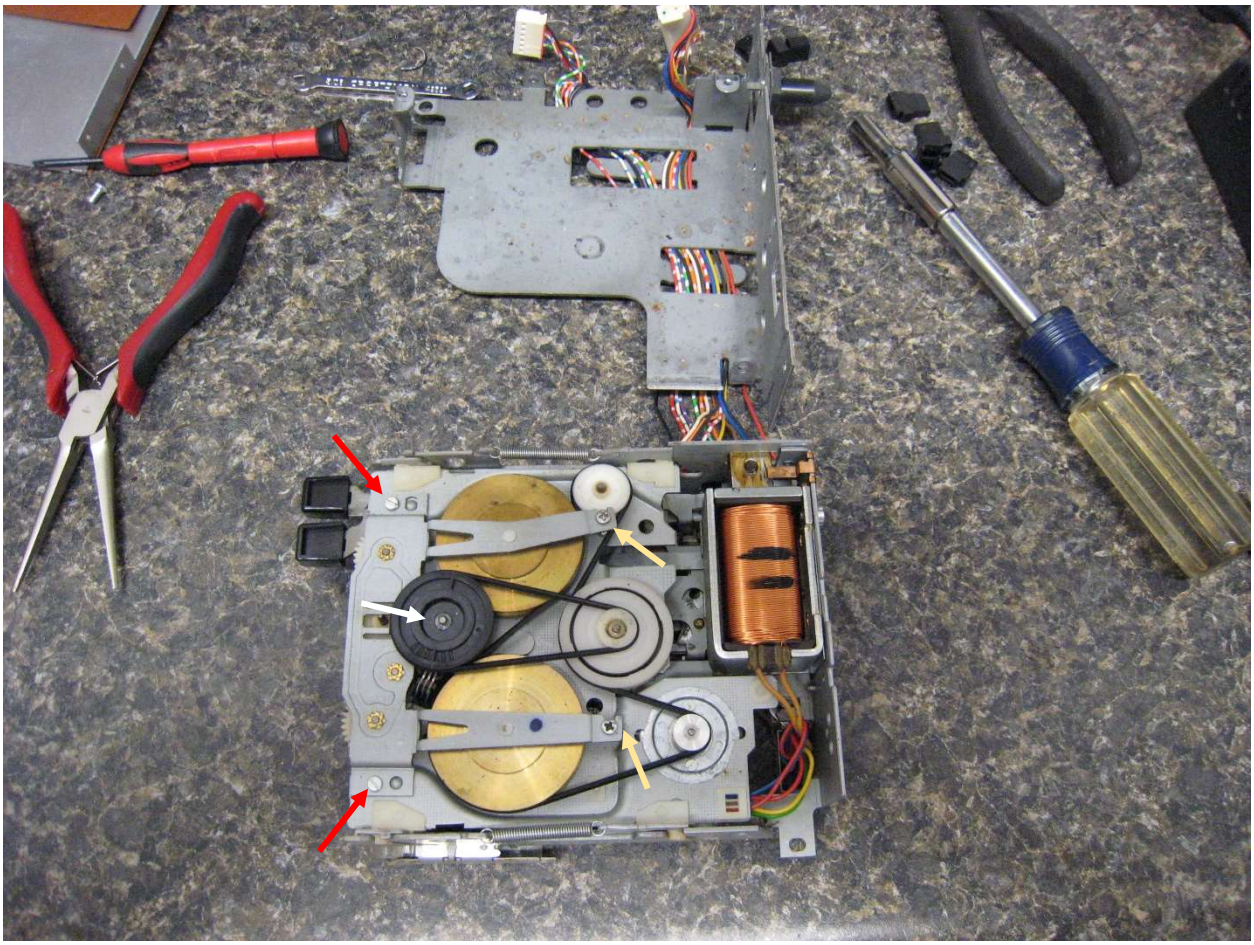
Once the board is completed, put it to the side while you work on the main unit.

Cleaning and Belt Replacement



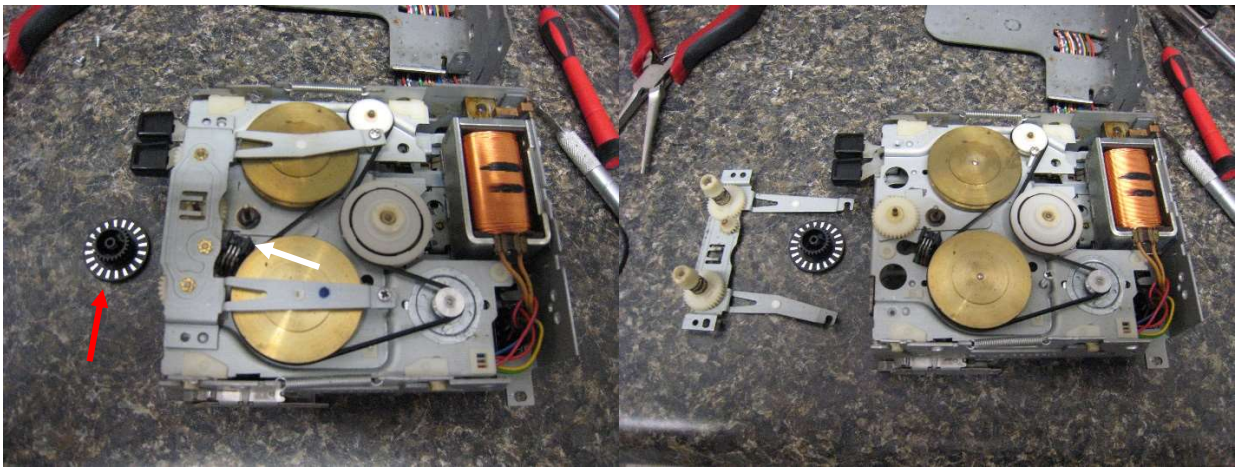
In order to get to the belts for replacement and cleaning, it is necessary to remove the lower cover of the unit. The lower cover is held on by three 3/16” bolts, one of which has already been removed in a previous step. The remaining to are shown in the images above with red arrows pointing to them. Remove these bolts.

Removal of the lower cover will require a bit of finesse as parts of it (the front bolt area especially) is entwined in the rest of the case. Take your time and remove the lower cover. You will be keeping the wiring connected, so when loose, just pivot the cover over. Once removed, you should have the unit laid out as shown in the image below.



Begin by using a hobby knife to gently remove the tiny nylon retainer holding the black pulley illustrated in the above with the white arrow. The is a tiny part, so keep track of it. Once free, remove the small drive belt and the black pulley as shown in the image below and to the left.

Next, remove the two slotted screws holding one of the drive gear assemblies. NOTE: you do not have to remove the small Philips head screws (gold arrows in above image) as the bracket is slotted and can be removed with the screws in place. Once free, remove the drive gear assembly. Your unit should look like the image below and to the right.



At this point, we are ready to clean the unit and almost ready to replace the drive belts, but before that is done, this is a good time to discuss one of the most common failure issues with these units; the scenario in which you insert a cassette, the drive switches sides twice and then ejects the tape.

When you insert the cassette, the drive motor engages to move the cassette. As shown in the images above, the drive motor engages the longer drive belt. This longer belt drives the capstan, moving the tape. If you recall the discussion on the pinch roller and capstan above, I mentioned that this is what moves the tape at a constant speed.

As the tape is played, it is spooled from one side of the tape to the other, and as it moves, the amount of tape on each side varies with the feed side getting smaller and the pull side getting larger. This is a system where two pulleys are constantly changing diameter, so their speed of rotation with respect to each other is not fixed, it must continuously change as the tape moves.

To adjust for this, the drive mechanism for the tape spools is driven off the smaller belt drive via a clutch. You can see this clutch mechanism in the images above. It is in the white pully with the black ring. This clutch drive (via the smaller belt) keeps a light tension on the pull side of the cassette to ensure that the tape does not get jammed.

On the underside of the black pulley (red arrow in the above image to the left), are a set of reflective strips. The optical sensor (white arrow in the above image to the left) must emit some kind of pulse which is reflected back. When it detects the reflections, it knows the tape is in motion. When a tape reached the end of the side, the tape is no longer moving, which causes the reflections to stop. The deck then engages the auto-reverse mechanism to start playing the other side of the tape.

So, in this failure mode, the tape deck believes that the tape itself is not moving, tries switching sides to account for the fact that it could be the end of the side, and then must have some counter or logic that ejects the tape if it still does not detect motion or continuously flips sides.

I've read many times on the Internet that this issue is caused by the optical sensor failing, and that the part is no longer available, and this very well may be the case in some circumstances, but the unit has no moving parts and looks to be sealed pretty well, so I'm not sure how many are actually failing.

There are several other conditions that could cause the deck to believe the tape is not moving. These include:

- Worn drive belts – if the drive belts are worn and/or broken, this would certainly cause the condition.
- Jammed mechanism/stuck motor – a problem here would have the same effect.
- Inoperable/slipping pinch roller/capstan assembly – If the pinch roller and capstan are not making good contact with each other, they cannot effectively drive the tape. Remember, the force on the tape spools is very light, it's just enough to take up slack. If it were stronger it would stretch the tape itself.
- Dirt on the reflective wheel – These units collect dust, dirt, and humidity (especially in convertibles), and over time this build-up can affect the amount of signal being reflected back to the sensor. Each one of these that I have disassembled has had noticeable build-up on the reflective surface.

With a good inspection, cleaning and belt replacement, you should address all of these on your unit.

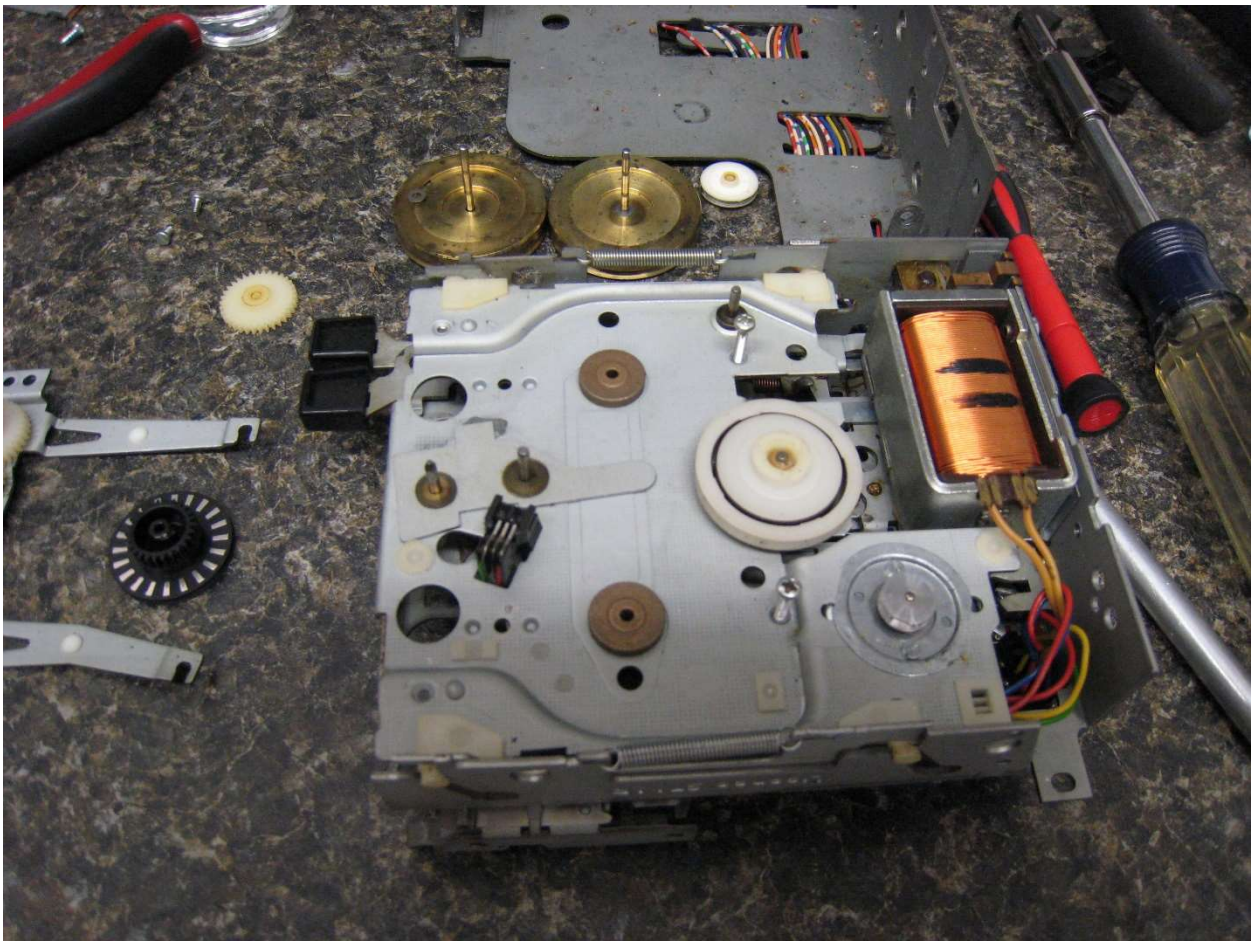
To clean the unit you will need some rubbing alcohol and a whole lot of Q-tips. There is nothing magical about this part, just dip the Q-tips in alcohol and use them to swab the unit clean EVRYWHERE you can.

You will find that you can remove almost all the pulleys for cleaning.

When cleaning, be sure to get in the belt groove on the pulleys and to use the alcohol to remove the original grease from the pulleys. After so many years, the grease has dried out and should be replaced.

On the gear assembly you removed first, there is a small gear which is held on by another thin nylon retainer. Use a hobby knife to remove the retainer and be sure not to lose it.

Once cleaned, your unit should look something like the image below.



It's now time to reassemble the pulleys and belt assemblies.

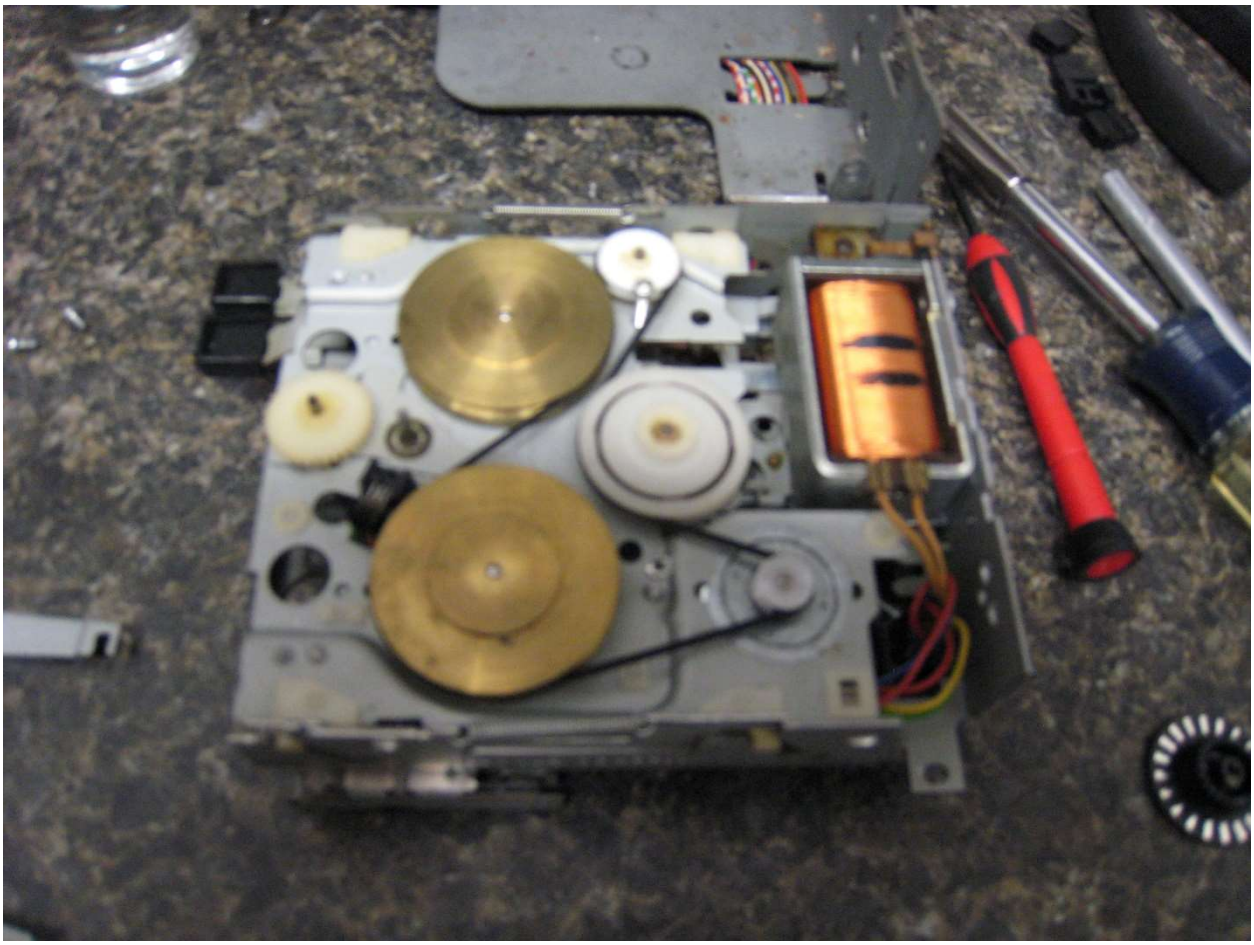
Start with the large brass pulleys. Place a very small amount of grease (I used white lithium grease) near the base of the shaft. Do not grease the entire shaft as the upper portion of the shaft is the capstan and is used to drive the tape. We don't want any grease on that part.

Previously in this section, I defined wow and flutter. The reason the two capstan drive pulleys are large and brass is to minimize wow and flutter. The two large pulleys act as flywheels to even out the power output of the drive and help keep the speed constant.

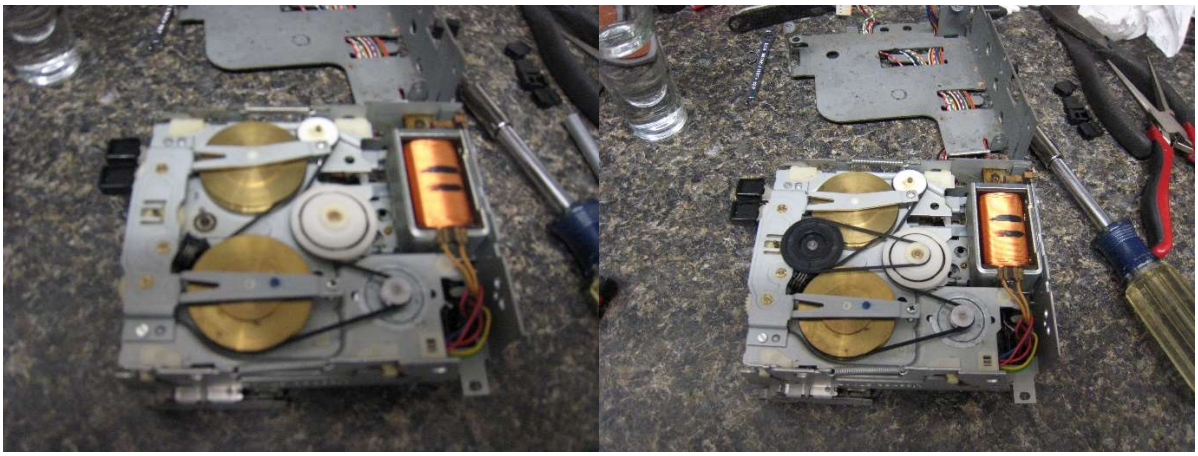
Lightly grease the contact points on the smaller pully and the front gear and assemble them onto the shafts. You can now install the longer belt.

The belts used in the units are square, and they fit into v-shaped grooves on the pulleys. When assembling, pay close attention and make sure the belt is correctly in the pully grooves and it is not twisted.

Your unit should look something like the image below.



Assemble the front gear drive unit and install it by sliding the two Philips head screws on the unit into the two slots on the bracket and installing the two slotted screws at the base. Your unit should look like the below left image.



Once the drive gear assembly is installed, install the black gear and secure it with the thin nylon retainer. Once secured, install the smaller belt.

Test spin everything with your fingertips to make sure it all moves smoothly.

At this point, the drive assembly is completed.

Belt Part Number and Ordering Information:

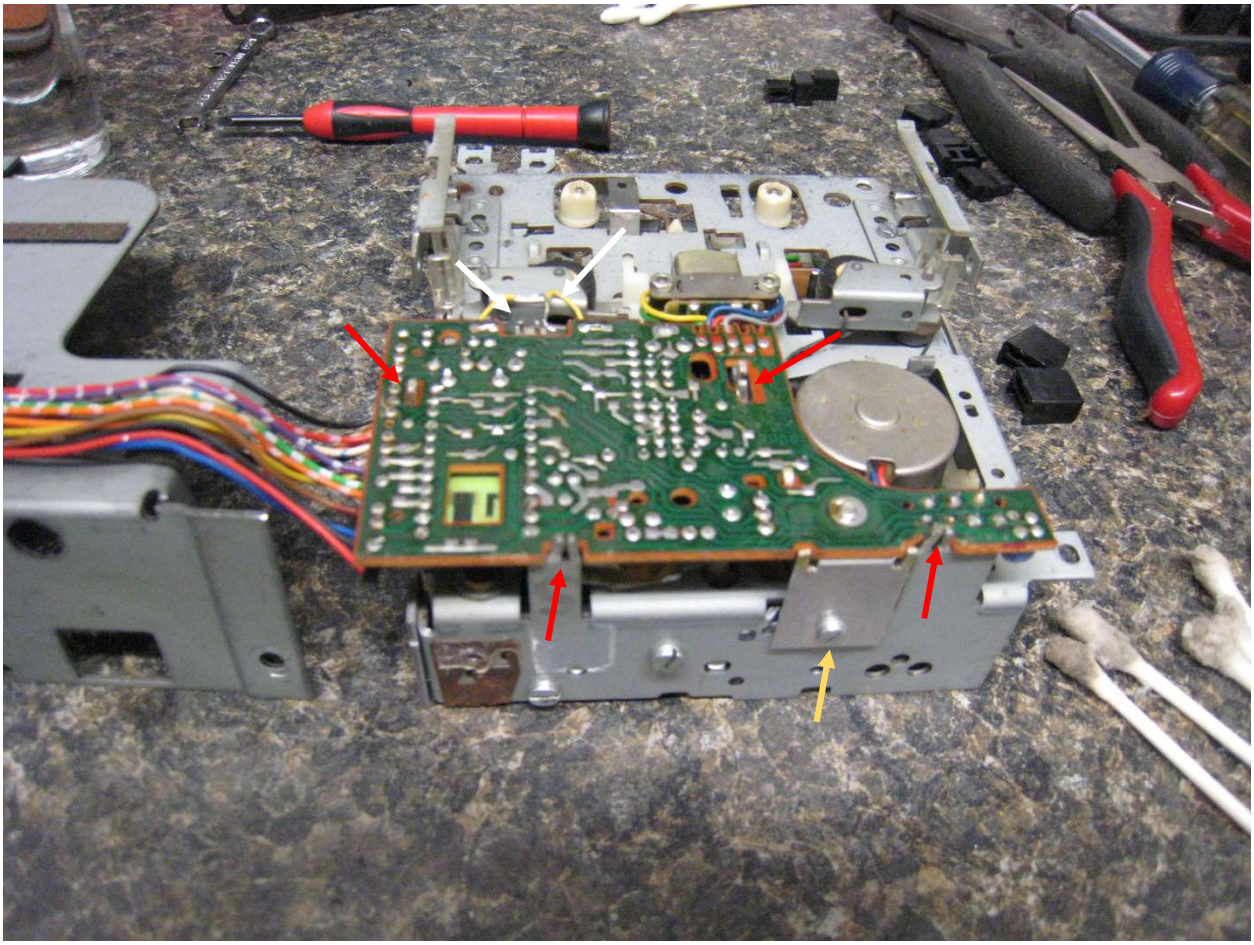
Kens Electronics
https://www.kenselectronics.com/lists/belts.htm

Description	Part Number	Qty
Short Drive Belt	AV-SBS4.9	1
Long Drive Belt	AV-SBS9.2	1

If you flip the cassette unit over, you will notice there is a circuit board on the unit. Hidden underneath this circuit board are two more electrolytic capacitors. Replacing them is a more advanced operation and I will describe it below, but if you are uncomfortable with performing it, I would suggest skipping the replacement and moving on to the next section which deals with cleaning the pinch roller/capstans and tape head.

If you're game to replace these last two remaining capacitors, read on…

Place the unit so that the circuit board is facing upwards and the rear is towards you as shown in the image below.

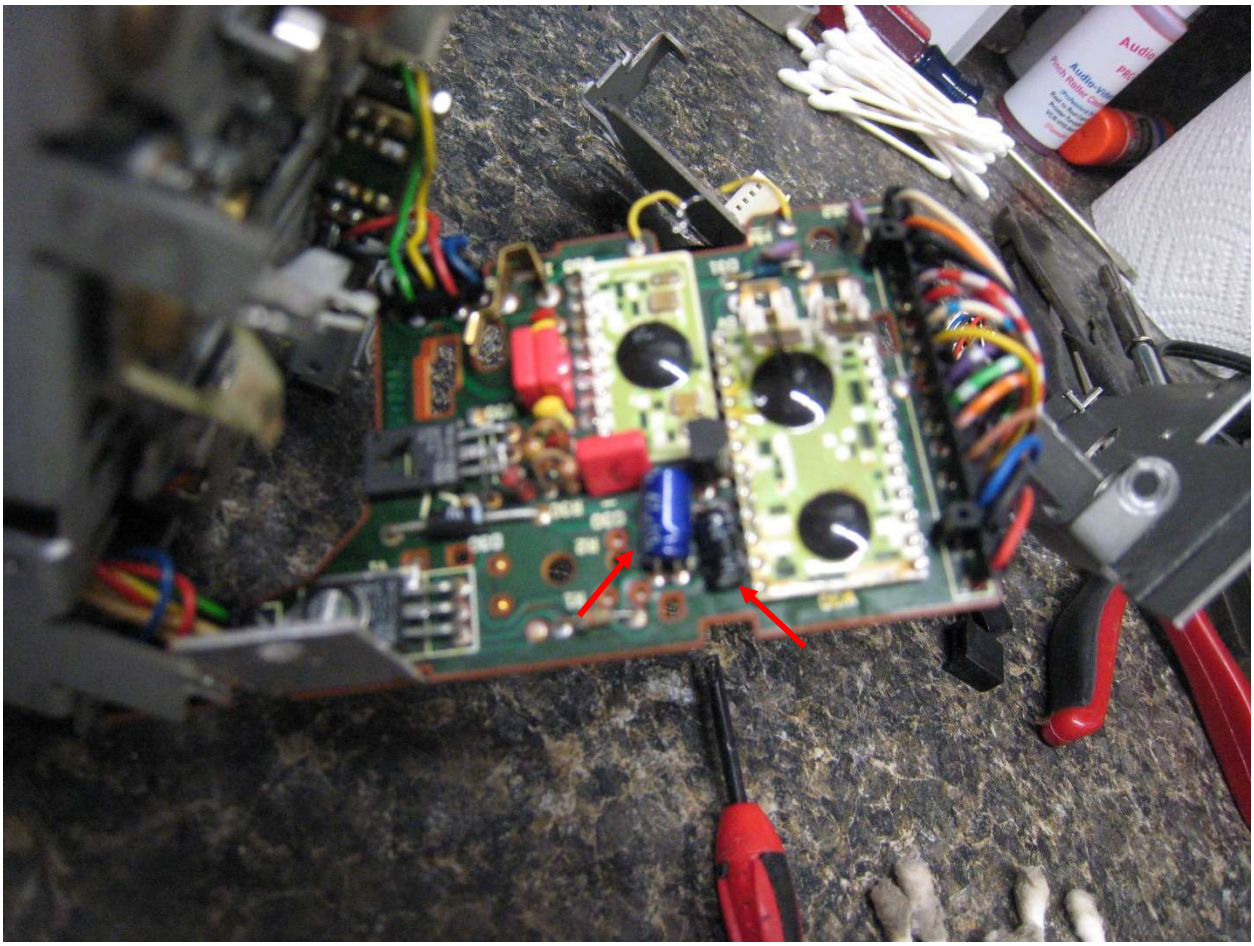


I would highly suggest de-soldering the connections to the eject solenoid (white arrows in image above) as part of this procedure. Having these small wires connected while you are moving the board around is a recipe for ruining the solenoid (ask me how I know).

Once the solenoid is disconnected, you can pinch the metal tabs that hold the board together (red arrows in above image) to release the board. Only pinch these closed enough to remove the board as you will have to expand them later to re-attach.

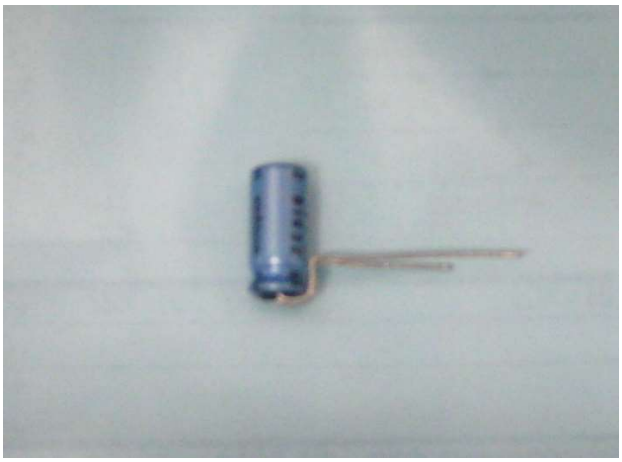
Finally, remove the slotted screw at the rear of the unit (gold arrow in the above image). The board should now be loose and move freely.

I found it easiest to stand the cassette unit on its side, allowing the circuit board to pivot out as shown in the image below. The two capacitors are shown by the red arrows.



The larger capacitor on the left is a 47 µF 10v, and the smaller one on the right is a 1 µF 50v. They are included in the ordering list for the radio in the beginning of this section.

What makes the replacement of these capacitors difficult is that there is very little room for the capacitor. The capacitors I ordered were taller than the stock units, necessitating some creative bending of the leads to get them to barely fit within the space. As shown in the below left, I had to bend the leads to let the capacitor overhang the board holes.



After replacement, board should look like the image above and to the right.

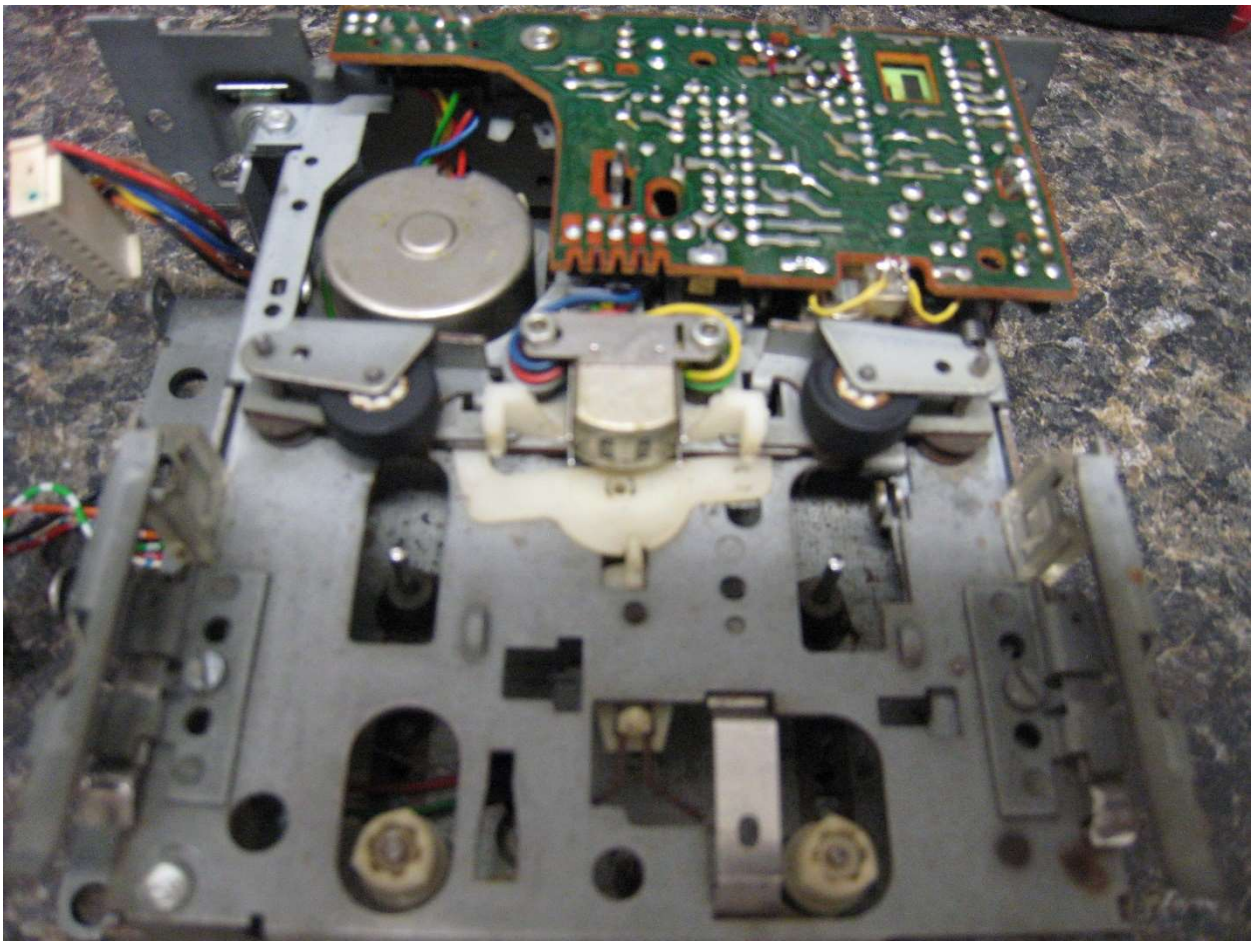
Re-assemble by gently placing the circuit board back into place. Attach the board using the slotted screw at the rear of the unit and by expanding the metal tabs.

Complete the assembly by re-soldering the leads to the eject solenoid.

You can now re-attach the lower cover using the two 3/16” screws you removed in the first step of this section.

Cleaning the Tape Head, Pinch Rollers and Capstans

The remainder of this procedure is just standard cassette deck maintenance. Flip the cassette unit over so the tape head unit is facing upwards as shown in the image below.



Using Q-tips dipped in alcohol, clean all of the dust and dirt from the unit itself. Be sure to clean the capstan drives with alcohol to remove any lithium grease which may still remain after you assembled the drive assembly.

I reconditioned the pinch rollers and tape head using the below solutions from Amazon. I am listing the link only as a source of reference, but as you can see in the above link, after reconditioning, the pinch rollers have good color and were very pliable.

https://www.amazon.com/gp/product/B00JDG86OE/ref=oh_aui_detailpage_o05_s00?ie=UTF8&psc=1

Old school audiophiles might also suggest demagnetizing the tape head. However, since these units were not capable of recording, they are not susceptible to head magnetization and the process is unnecessary.

The reconditioning of the cassette unit is now complete and it is ready to be assembled back into your receiver unit!

Adding an Auxiliary Audio Input

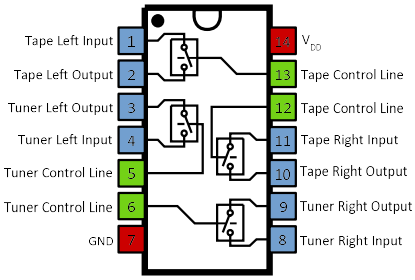
Introduction

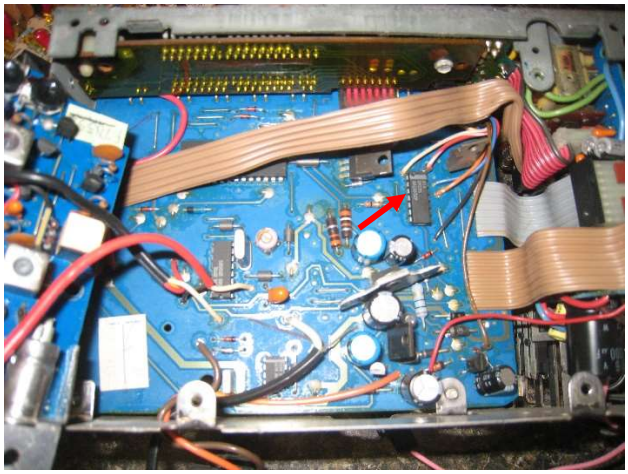
If you're not interested in reading about the details of how we are adding an additional input to your radio, then skip ahead to the Adding the Input section for the details on performing the modification, but if you are interested in the behind the scenes, read on….

In the radio section, I discussed how the head unit is a combination of the tuner, cassette, and pre-amplifier components of a home stereo. The pre-amplifier section contains the tone controls like bass and treble and selects the input to which you listen.

Since we cannot truly add an additional input to the head unit, we are going to essentially hijack one of the existing input lines for the auxiliary input.

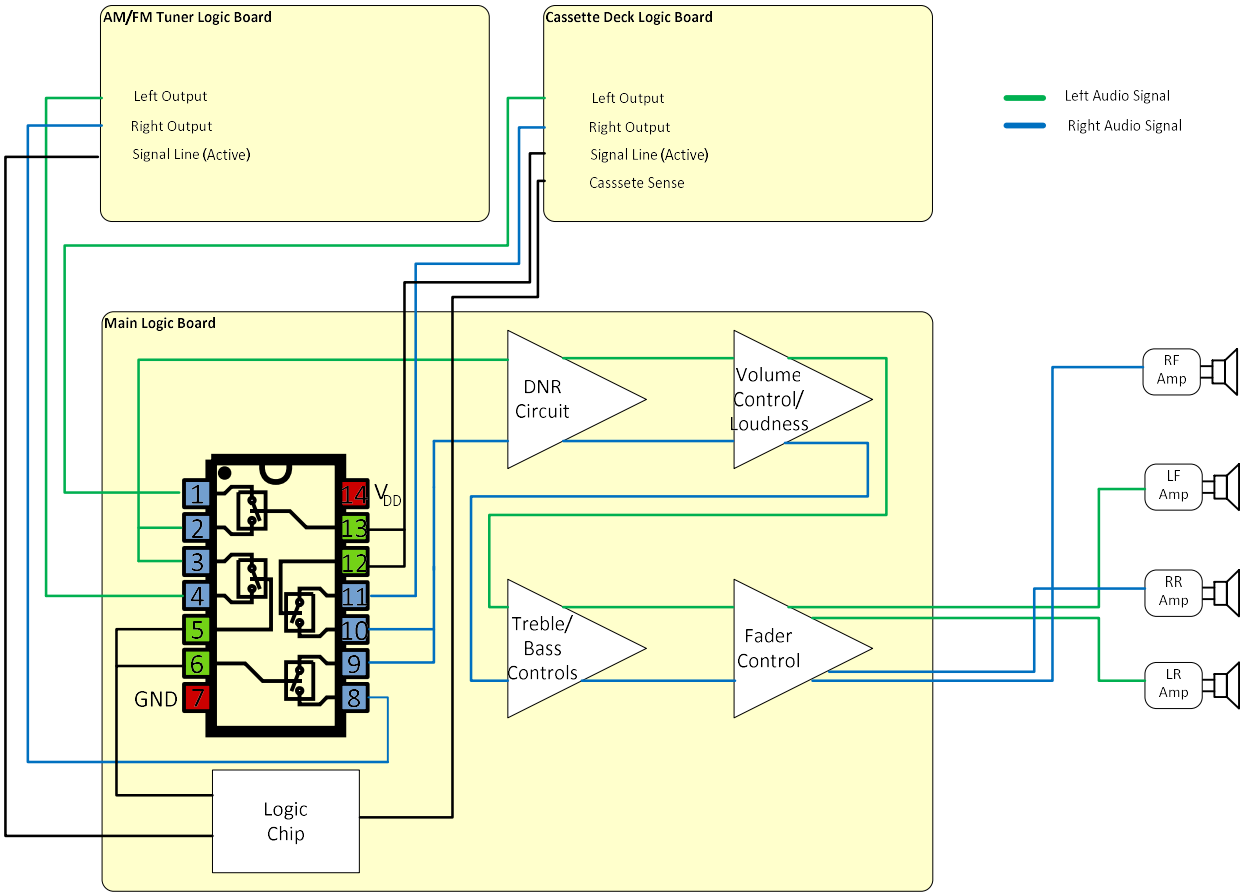
The switching mechanism used in the head unit is very simplistic. It utilizes a chip which contains four individual switches which are turned on and off with the use of a signal line. The four switches are used on the left and right signals for the cassette and radio, and the signal lines are used to tell the chip which source is on and working. The below diagram on the left is an illustration of the chip and its pinout details. The picture below on the right shows you the actual chip (red arrow) on the logic board in the radio.





When the tuner is active, the logic chip energizes pins 5 and 6, which connect the tuner outputs to the equalization circuitry. This is the default setting. When the tape is in use, pins 12 and 13 are energized by the cassette unit, connecting the cassette. The logic chip keeps track of which input you are using by monitoring a signal from the cassette unit. If it detects that the cassette has power and is playing (you inserted a cassette), it will de-energize pins 5 and 6, which disconnects the tuner. It must ensure that only one set of inputs is energized at any time, because Delco simply ties the outputs from both signals together and sends them to the equalization circuitry. If both the radio and cassette signals were energized, you would get a combined signal which included the tuner AND the cassette coming out of the speakers.

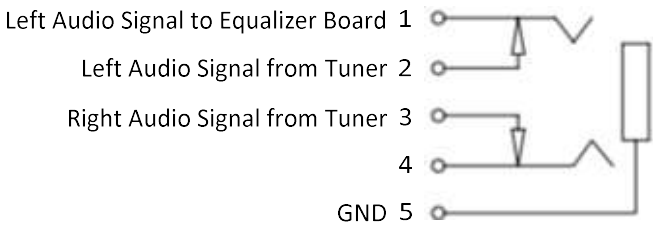
The diagram below shows the logical layout of the preamplifier circuitry and how it is connected.

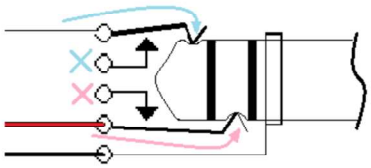


While it is possible to add the auxiliary input to either the tuner or cassette input, the easiest path is to use the tuner input as using the cassette input would require us to also switch some DC current to have the tuner disconnected as a source.

The goal is to have the tuner playing by default, but to hijack that signal path when a device is plugged into the auxiliary jack. This is done by using a specific type of auxiliary jack designed for this very purpose. In effect, the signal from the tuner board is going to exit the radio, travel to the auxiliary jack, and then back again into the equalizer board. The diagram below shows this kind of jack. On the left, no device is plugged in and the tuner signal is routed back to the equalizer board in the radio. On the right, a device has been plugged in to the auxiliary jack.

Plugging in the device physically disconnects the tuner from the return line and connects our device to the lines going to the equalizer board in the radio.





The tuner continues to work, but the signal from the tuner isn't going anywhere. This is identical to when you insert a cassette tape into the player. Best of all, your device has been inserted into the equalization board, so the tone controls all continue to work.

When you pull your device out of the jack, the tuner is once again connected and the radio plays. There is one caveat; you should always disconnect the auxiliary device by pulling the plug from the car jack, and not the device. Pulling the cable from the device will still leave the tuner disconnected.

Now that you understand the why, let's get to the how.

Adding the Input

Before starting this procedure, you should print out a copy of the diagram located in Appendix 2. This diagram will help you lay out your auxiliary input wiring and keep track of it during the procedure. Your receiver should look be disassembled to the point of having the tuner board and cassette unit removed, giving you access to both sides of the logic board (see Page 13).

There are a million and one ways of wiring an auxiliary jack, I am giving you the way I did it, but feel free to customize your implementation for your installation. For my setup, it is important to be able to disconnect both the head unit and the jack from the wire connecting them, preserving the ability to easily disassemble the car's interior. In order to accomplish this, I used computer networking cable and jacks.

By starting with two small male to female extension cables as shown in the image below and to the left, I was able to remove the male portion, leaving bare wires and the female connector as shown in the image below and on the right. By attaching the female sections to the head unit and the aux jack, I can connect the two using a standard network cable. This will allow me to remove the radio and console panel from the car without having to pull a bunch of wire.

Start by cutting the male connectors from your two network extension cables. Be sure to leave about 1-2 inches of wire attached to the male connector. After cutting, strip the main insulation back, exposing about 2 inches of the eight wires within the cable.

You will need five wires to carry the signal and ground, so pick five of the wires and write their colors down on the diagram you printed. Remove the other three wires you do not need from both cables

with the female connectors. Strip a small amount of insulation from the tends of the wires and tin them with your soldering iron to prepare them for installation.

In the Introduction to this section, I explained that the aux jack we are using will, when no plug is present, connect the radio to the logic board. Without the jack being present, the radio signal will not be routed to the logic board. You can fix this issue by making a jumper out of one of the male ends of the networking cable by soldering the input and output wires for each side together (ground wire not needed in jumper). I would highly suggest you make one of these jumpers. Doing so will allow you to test the radio prior to installing every component. The images below illustrate the completed jumper.

Installing the receiver side of the aux input is relatively straightforward. Due to the layout of the logic board, jumpers were required to connect the traces we need to tap, making the process very straightforward. The image below shows the two jumpers that need to be removed (red arrows) and an accessible solder point for a ground (gold arrow).