Repairing your Porsche 928 Central Warning System (CWS) controller

Disclaimer:

This procedure is for a 1984 Porsche 928 S controller.

Overview:

Under the left foot pedal (dead pedal) of the Porsche 928 lives the Central Warning System (CWS) controller. This miracle of 1980's electronics takes the inputs from the sensors on you 928 and compares them to a reference or another input and then drives the instrument bulbs in the pod cluster that illuminate the warning indicators on the dash display.

The system is implemented in an aluminum enclosure ~ 3.5" x 5"x 2" that contains 2 connectors. Each one of the connectors is soldered to a circuit board inside the unit and the two circuit boards are connected together using three flexible printed circuits. One circuit board contains a D8748 8-bit microcontroller. This controller has an 8-bit CPU, 1K x 8 of EPROM memory that stores the code that runs the system and 27 I/O lines that provide the sensor data to the microcontroller.
Over a period of time the solder joints on the circuit boards begin to corrode or crack and need to be "re-flowed" to re-establish a solid connection. Socketed parts need to be "reseated" in the socket every now and then to re-establish a good connection.

The unit that you see in this write-up did not function at all at first (there was no warning lights at all). Upon re-flowing the solder on the main connectors, flex circuits and cleaning pins – all the warning lights would come on but not go off when the car was started. Reseating the microcontroller was required to get the unit to function correctly.

Tools Needed:

Straight blade screwdriver
5/16" nut driver, socket or wrench.
Needle nose pliers
X-acto knife – (BE CAREFUL)
Soldering iron, 15 to 40 watt with a good tip.
Resin core solder
Damp sponge or cloth
Alcohol or flux remover.
Q-tips.
Magnifying glass (10x), eye loupes (10x) or hand band magnifier
A small pick is helpful in removing old flux buildup.
A few sheets of paper.

Preparation:

Before undertaking this project get you soldering iron hot and make sure the tip is still in good shape and tin it as necessary. Get your sponge wet. Put some Alcohol in a small container with Q-tips close. If you are not familiar with soldering there are several websites that give basic instruction. If you have never done electrical soldering before I recommend you practice before doing this. http://www.kingbass.com/soldering101.html gives some good information and pictures of good joints.

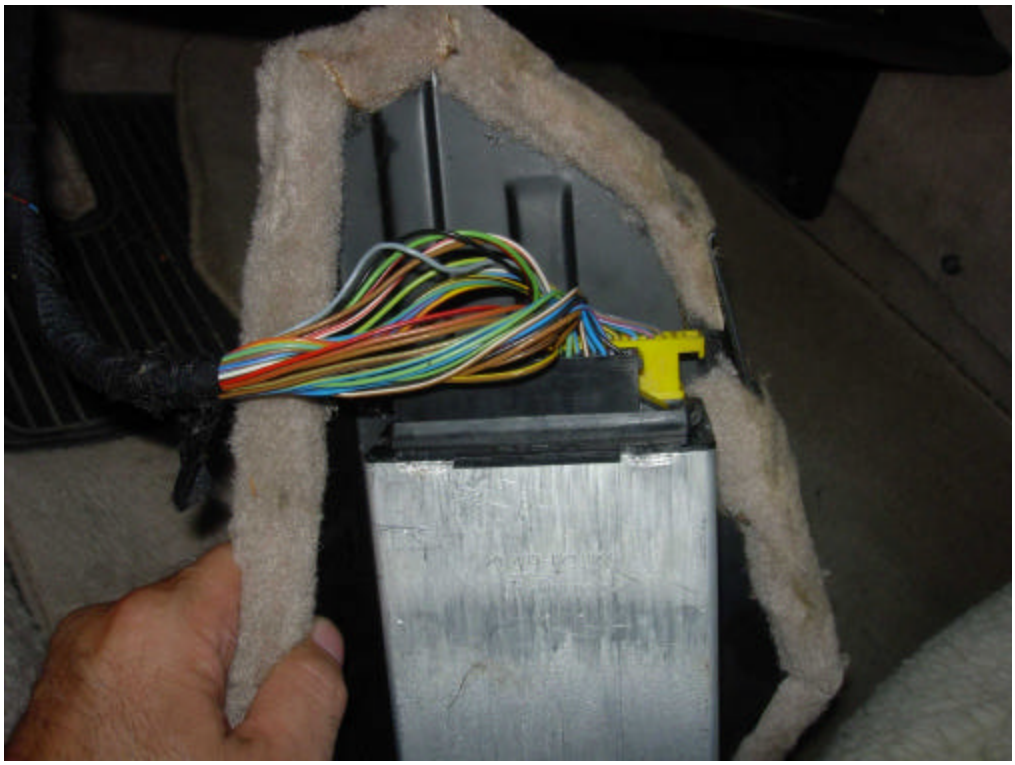
Current flow diagrams for the CWS are on page 97-17 of the workshop manuals. I found that MY 1984 pinout was slightly different than the diagram.

Power is supplied on the black connector thru the solid RED wire. +12V should be available at this pin (YMMV) with the key OFF. If no voltage is present at the pin; then troubleshoot fuses and wiring harnesses before beginning this procedure.

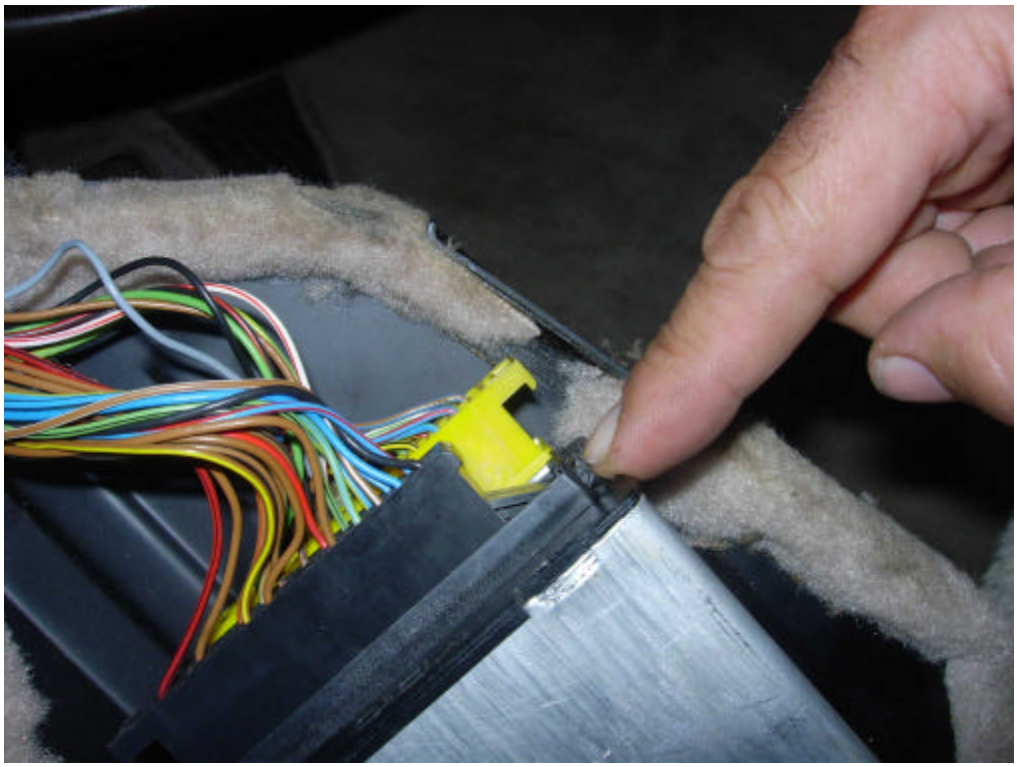
Procedure:

1. Disconnect the negative battery cable at the rear hatch.

2. Remove the screw for the dead pedal in the left driver's foot well. As you pull the pedal out notice two(2) wiring harnesses connected to the unit. One is a black the other yellow (you may have different colors).

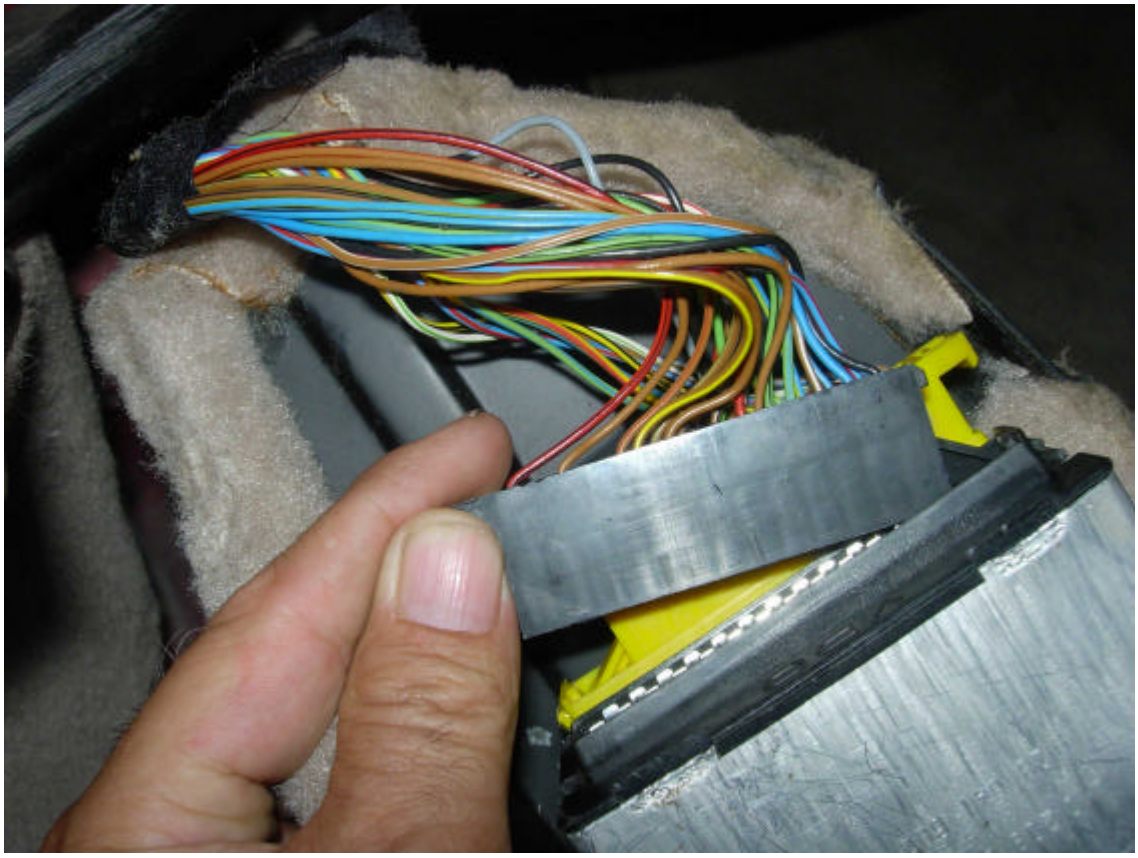


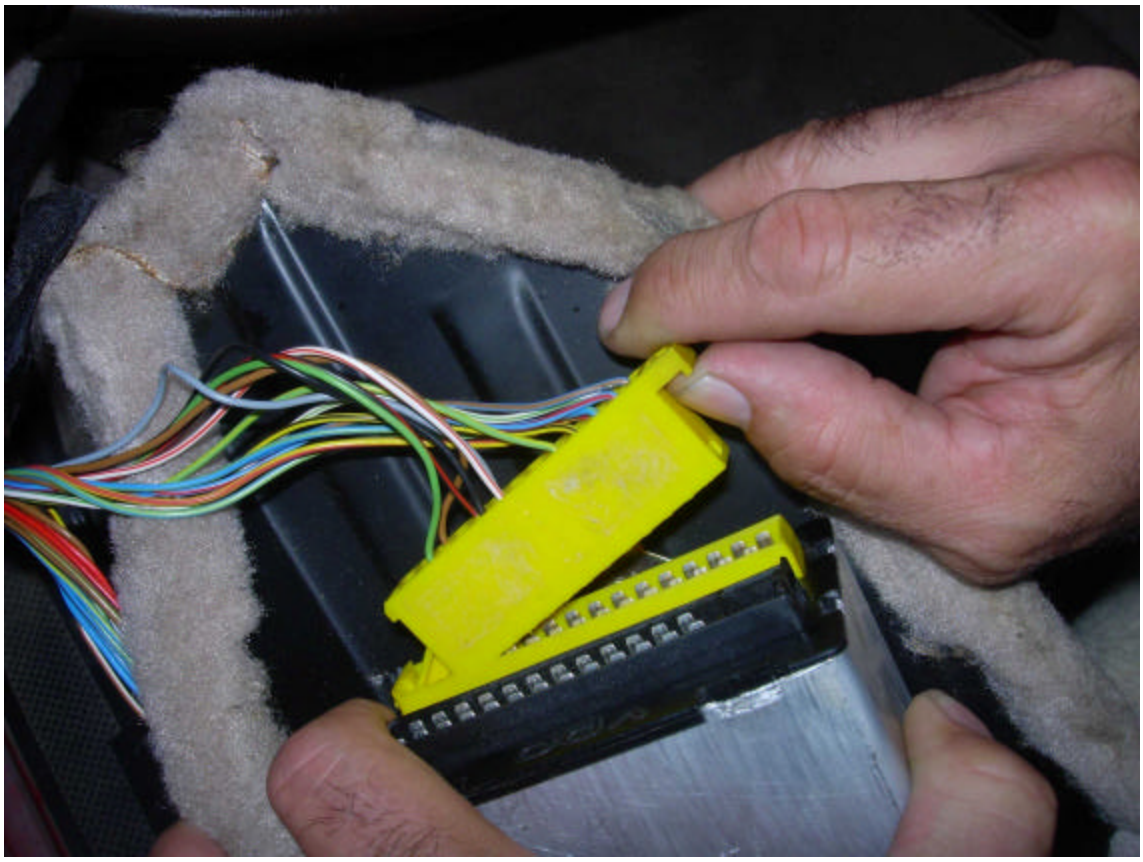
3. Disconnect the wiring harnesses from the controller. These are 25 pin keyed connectors. The connectors are keyed in opposite directions.



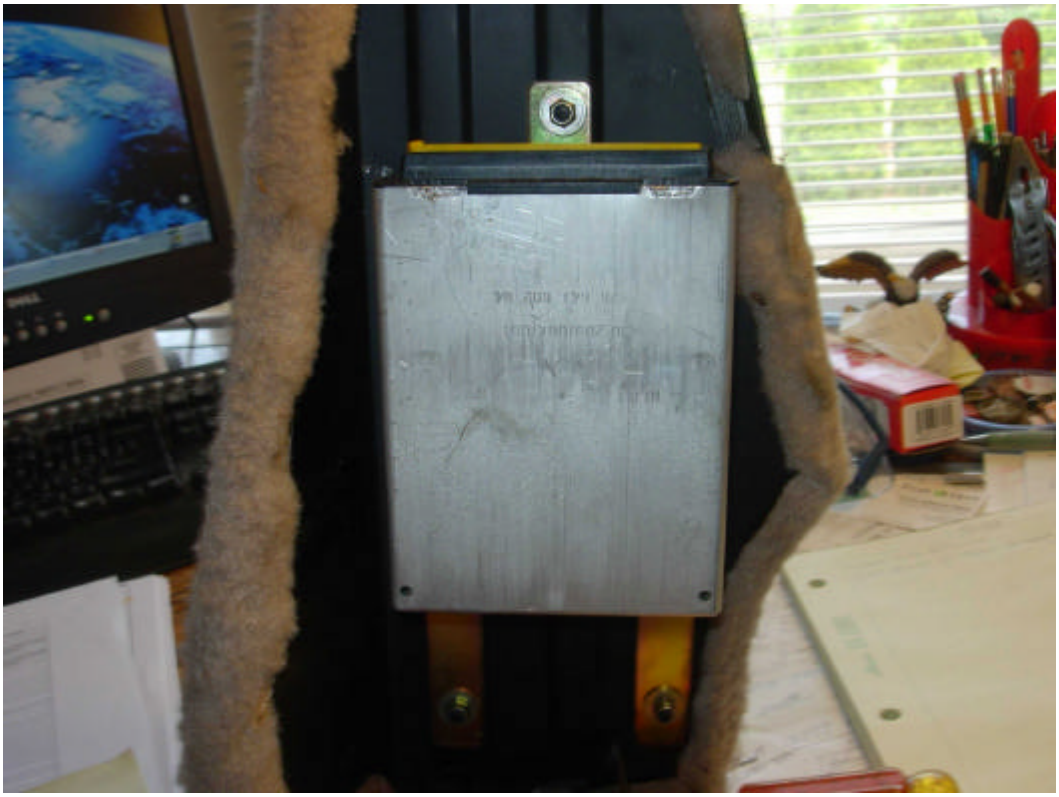
NOTICE the key.

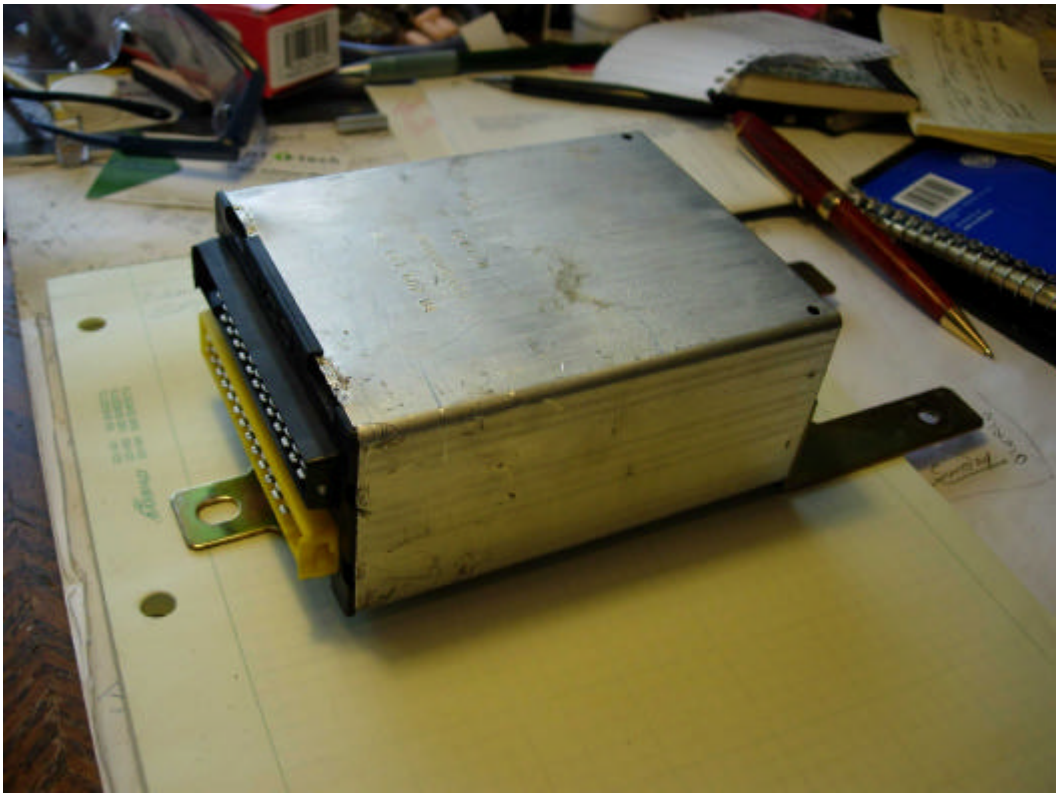
Disconnecting the harness – lift on the end opposite the key.





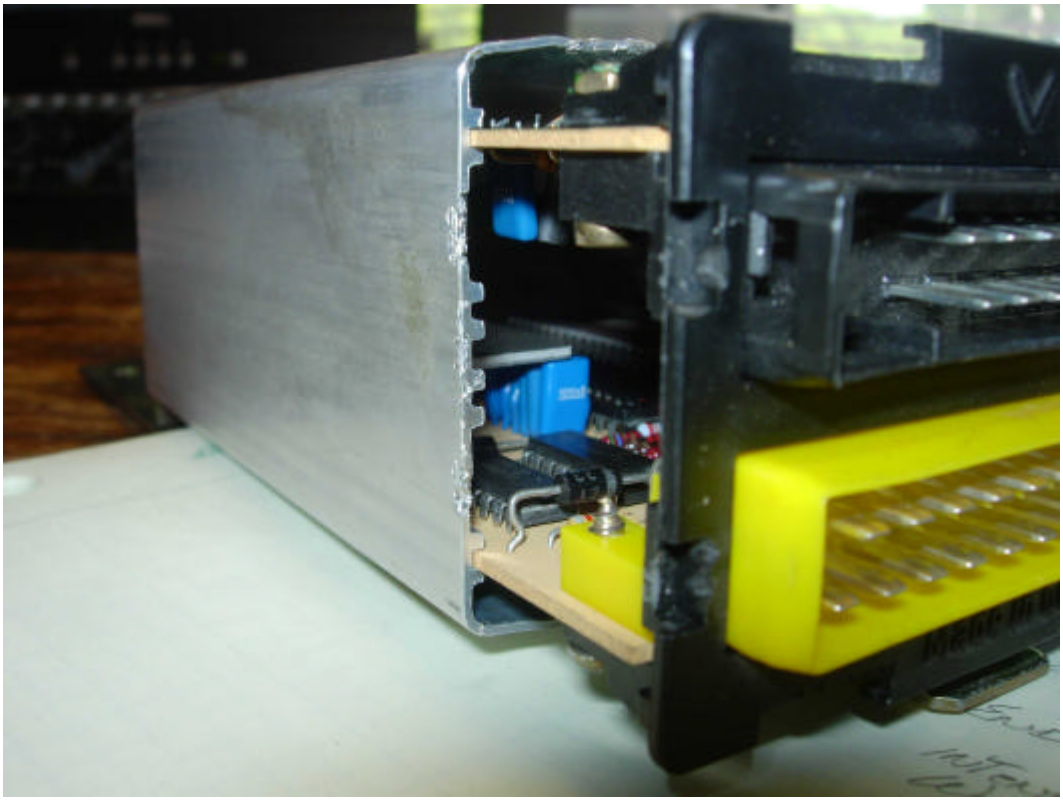
4. The CWS is attached to the foot pedal by 3 nuts. Using the 5/16” driver remove these nuts and washers. Separate the unit from the dead pedal.





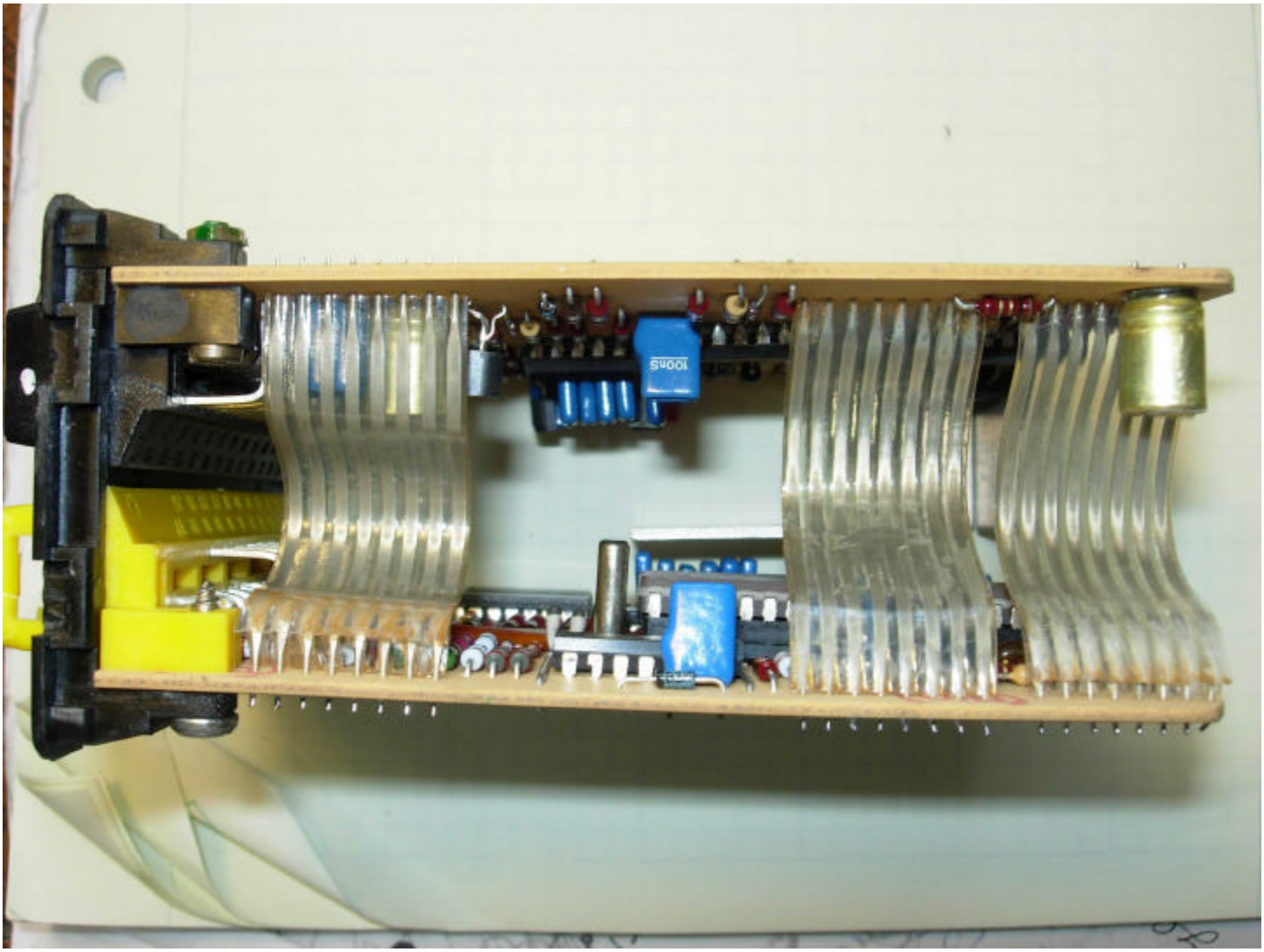
5. To open the enclosure requires using the screwdriver to pry the aluminum tabs (4 long – 4 short) out enough to clear the plastic face panel.

6. Once the plastic face plate will slide past the aluminum tabs, slowly pull the assembly out of the box. NOTICE that the circuit boards slide on groves inside the box. The assembly should slide out of the enclosure FREELY. If there is any resistance STOP. Check for debris or obstructions then try to free the assembly.



7. Once the assembly is free of the enclosure place it on the few sheets of paper on an open work area.

8. Become familiar with the assembly. You should have two(2) circuit boards attached to the face plate, one has a black connector, the other a yellow one with three(3) flexible circuits along one edge on each board connecting the two boards.



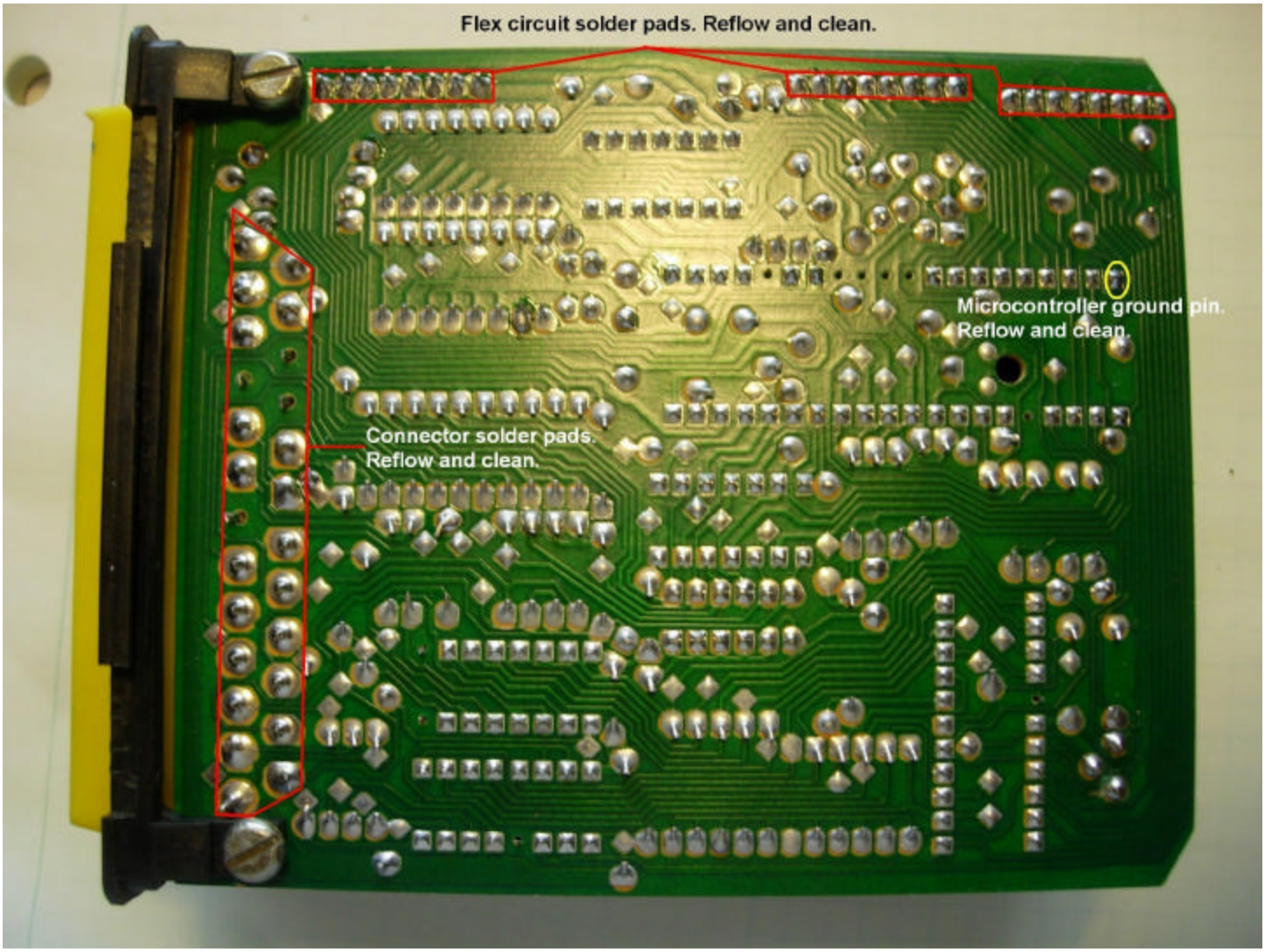
9. Inspect the assembly for broken parts and corrosion. Does the circuit board or components look burned or the surround area is black or dark brown? Does the enclosure and assembly SMELL burnt? This can indicate a component failure or something shorted.

   Inspecting cold solder joints on small parts requires magnifying tools. I use eye loupes (10x) and a pair of head band magnifiers (both from HF). The loupes allow you to see very minute cracks and determine if joints need repair. The head band allows you to see solder joints very well for repair.

   You may notice that the flex circuit plastic covering are becoming loose. The only way to correct this is to replace these or replace with ribbon cables.

   NOTE: If you have burnt circuit boards or broken components its time to replace the unit.

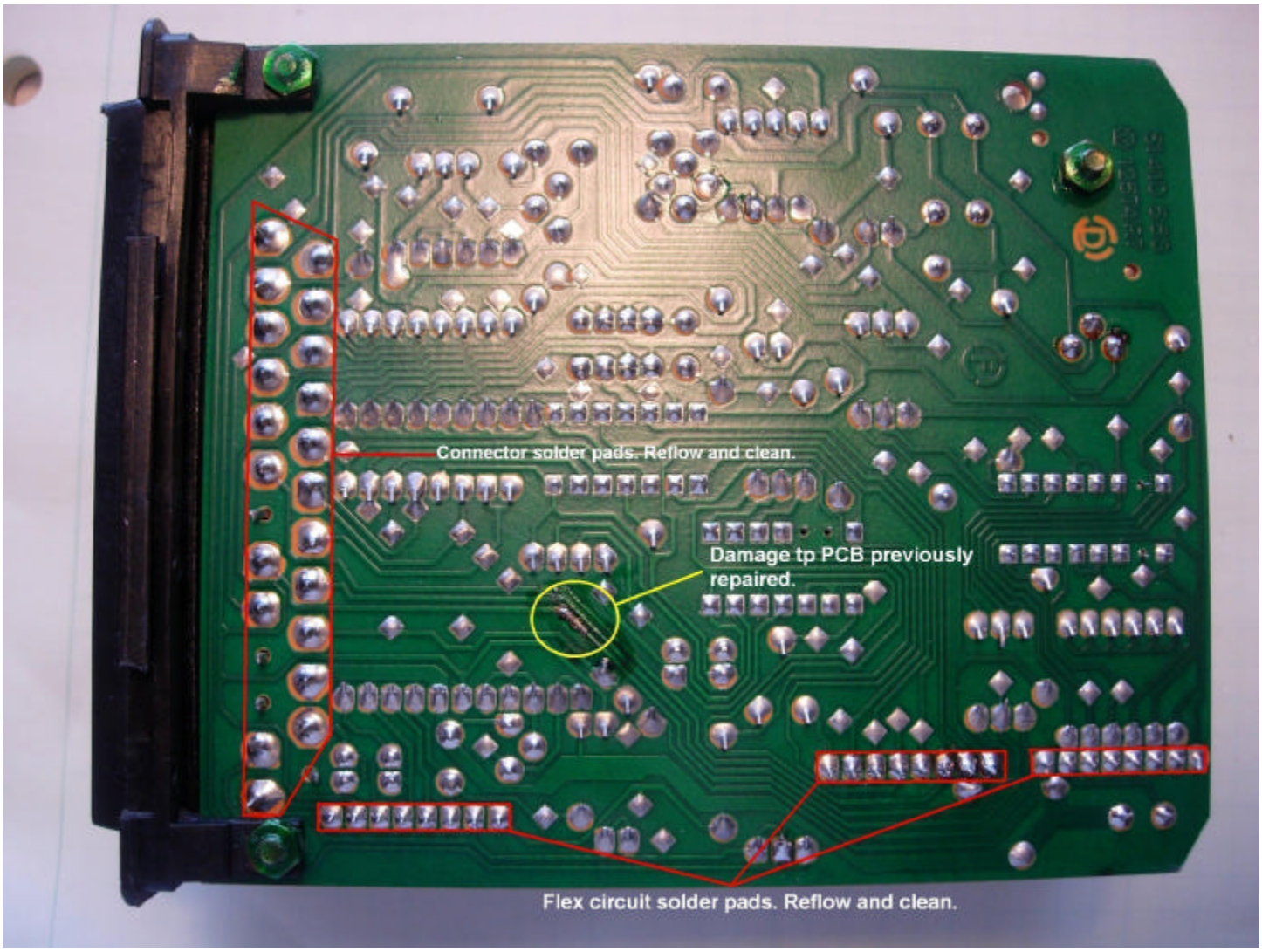
10. With no broken or burnt parts; locate the large solder pads just behind each connector on each board. These solder pads are the electrical connections for the connectors to the circuit boards. Since there is a lot of pulling on the connectors this is a high stress area. Re-flow the solder on these solder joints and clean. See re-flowing tips below.



Re-flowing solder joints:
To re-flow the solder joint; you have a hot iron in hand, a 3-5" length of solder in other hand. Place the tip of the iron against the solder pad AND the wire coming thru the solder joint. As the old solder just begins to melt, touch the solder to the iron tip and the solder joint. The solder will "WET" on the tip and "FLOW" into the joint, once that occurs; remove the heat and the solder and allow the joint to cool. Try to apply enough heat to re-flow the joint; but don't leave the iron on the joint for more than a few seconds. Once the joint has cooled, it may have flux around it, take a Q-tip and pull about half of the cotton off of one end (to create a small swab), then dip in your alcohol and wipe on the joint to dissolve the flux from the solder. Use the other end of the Q-tip to wipe the excess alcohol from the board. Flux removers can also be used instead of alcohol; however, they usually leave the board sticky so I prefer alcohol.

Look at you solder joint. It should be bright and shinny. If the joint is a dull grainy color or chunky; wait a few moments to allow the heat to dissipate and then re-flow it again.

11. Re-flow the solder on the pads of the other connector.



12. Locate the 3 flex circuits that connect the two circuit boards together and re-flow the solder on the joints for these. If the flex circuits are damaged they can be replaced with ribbon cable (available at Radio Shack or at least it used to be). See below on replacing flex circuits.

13. Locate the microcontroller ground pin (previous photo) and re-flow and clean. Use as little heat as possible on this solder joint at it connects to the microcontroller.

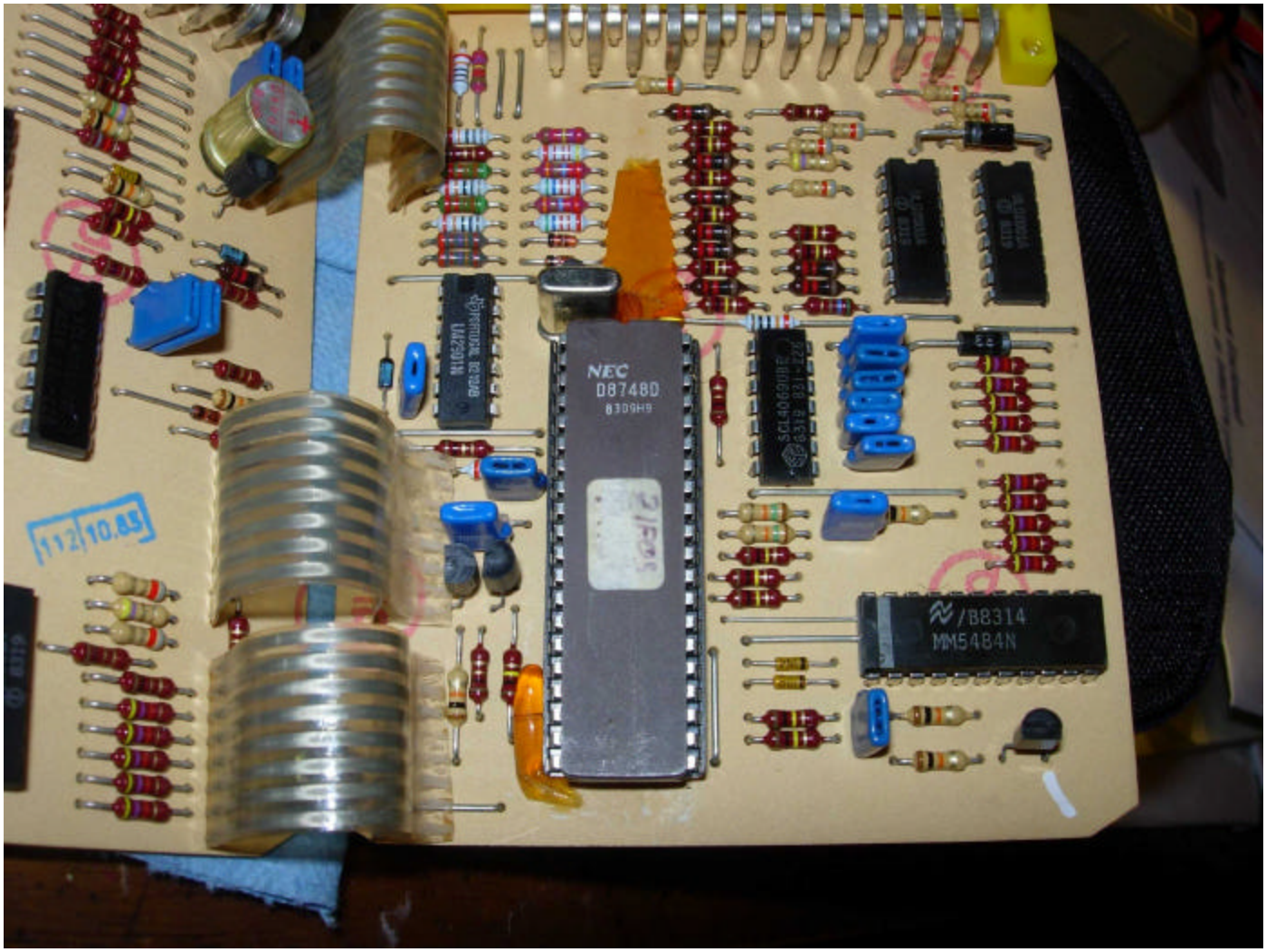
14. If during your inspection you find damage to the circuit board – all is not lost. If a trace is missing or torn as in the photograph. This can be repaired by taking 28 or 30 gauge insulated wire and simply replacing the entire trace with wire. Use a multi-meter to ohm out the trace/wire to see if it is conducting. Once you are satisfied with the repair is good, glue it down on the PCB with hot glue or epoxy. If you find previous damage that has been repaired (like the above) check it thoroughly to see if it has deteriorated and is no longer working.

15. At this point you have re-flowed the solder joints on the main connectors, the flex circuits that connect the 2 boards together, the microcontroller ground pin and repaired any possible trace damage. Use a Q-tip with alcohol and clean the contacts of the main connectors and the harness connectors.

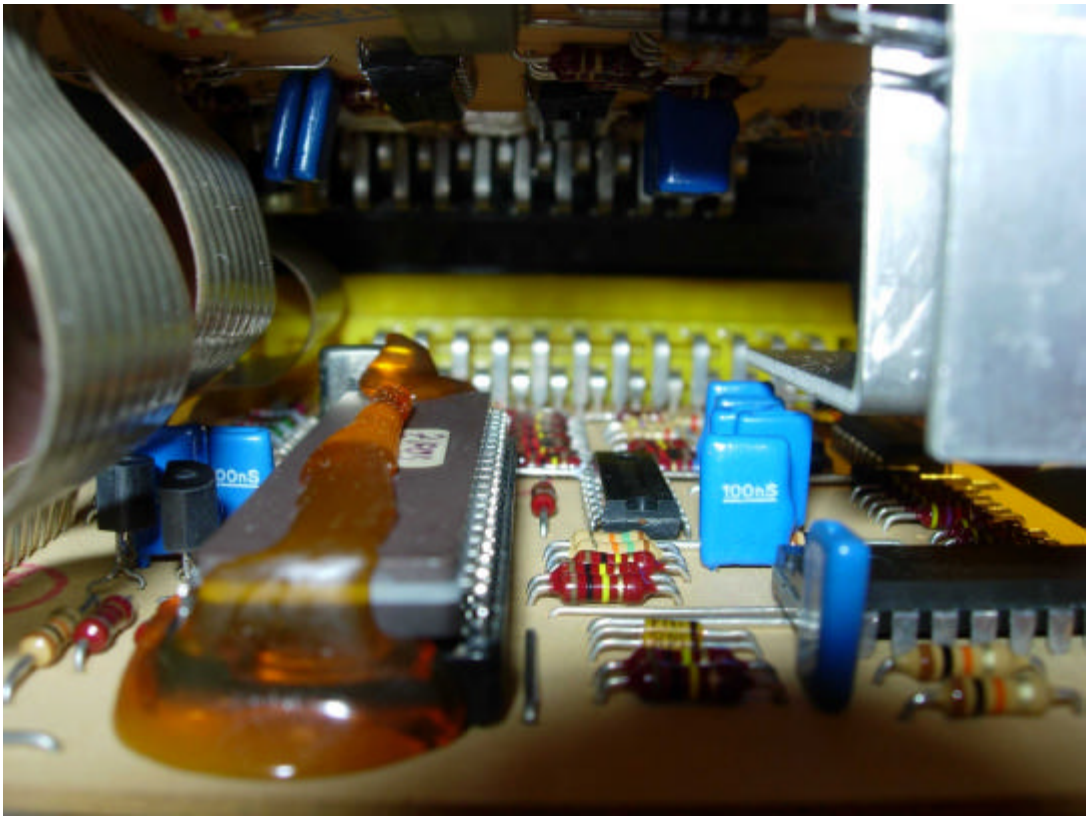
16. Check the harness connections for any frayed wires or bent contacts.

17. Test the unit by connecting it to the harness and reconnecting the battery. Perform steps in the testing section and see if the problem has been corrected. If so, go to the assembly section.

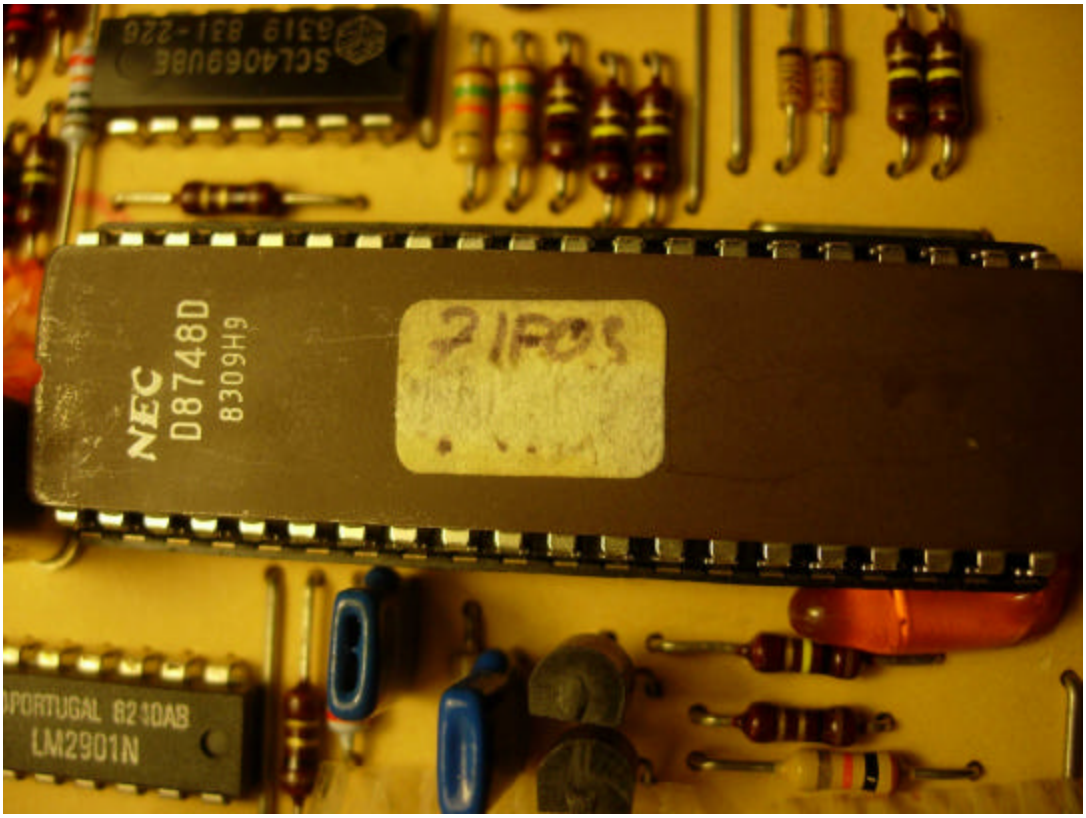
18. If you still do not have a functional unit. You can try reseating the microcontroller. To do this requires removing the faceplate. Each circuit board has 2 screws holding it on the faceplate. One set has screws with nuts and the other has self tapping screws. Remove the screws with nuts first. Turn the unit over and remove the self tapping screws. Stand the unit up with the main connectors facing up and pull the faceplate from the circuit boards. Open the circuit boards like butterfly wings. When you do this you will need to lay the circuit board with the microcontroller down you the work surface and support the other board. See photo (in this photo the glue has already been removed).



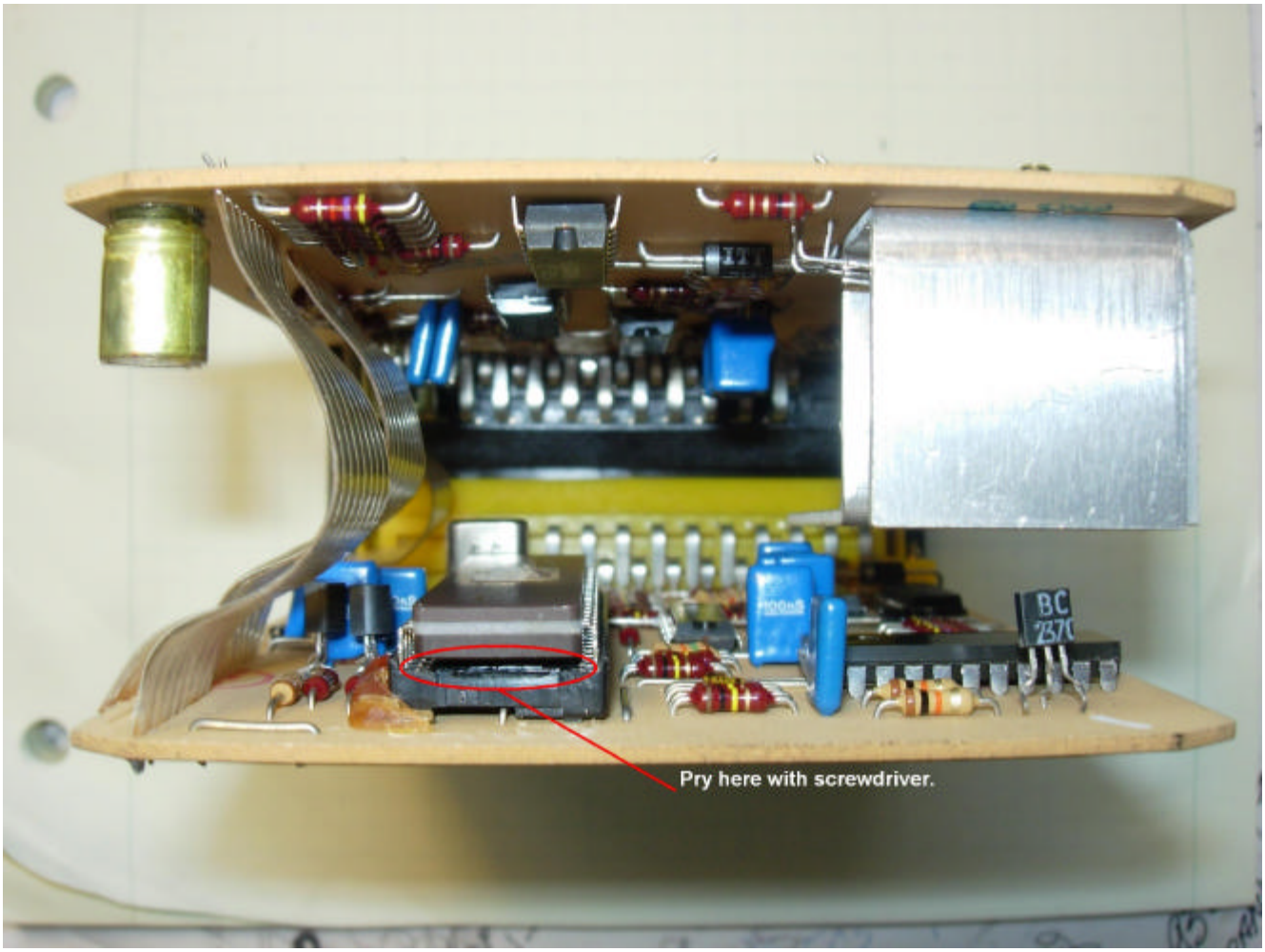
19. Once you have the circuit boards layed out and supported, remove the glue from the microcontroller. See below. Now if this was a new assembly we would likely tear the thing apart trying to get that glue off; however, just like time has created problems with this unit, it has also been an enemy to the glue. The glue has lost a lot of its sticking power and can be removed using an X-acto knife around the edges; I cut down from the top at the edges, and then pried the glue back away from the controller.



This was the result.



20. Once the glue has been removed. Insert the blade of a flat blade screwdriver in between the IC package and the socket and GENTLY……VERY GENTLY pry up. Do this on BOTH ends of the controller to lift it up. **DO NOT REMOVE THE PART FROM THE SOCKET**. The goal here is to raise it up just a little and then push it back down into it's socket and reseat it. The reason we do not want to remove it is this part is a CMOS part which is VERY sensitive to stray static charges when it is not installed in the circuit.



21. Once the IC has been lifted. Place your thumbs at each end and push down (moderate pressure) which should reseat the microcontroller. Check to make sure the package is not tilted side to side or end to end.

22. At this point, I attached the faceplate and reconnected the unit and it was functional. If your unit is working go to the testing and assembly section.

23. If you still have a non-functional unit, trying re-flowing all the other solder joints on the boards. Starting with the microcontroller. When you do this, re-flow a pin and then wait 60-90 seconds to dissipate the heat before you go to the next pin so you do not overheat the part.

24. If after these steps the controller is still not functional, further troubleshooting involves taking voltage measurements of the microcontroller and other IC's to determine if they have power supplied to them. This requires you to have the device pinout's for the parts which is available on the device datasheets. If you want to pursue this; let me know and I will send you the datasheets. Most of the logic on the boards runs on +5 volts (including the microcontroller) so the input of +12 volts must be regulated down to +5V. If the regulator fails the unit will not function because power is not being applied to the device power pins.

25. Beyond taking voltage measurements things become quite involved and requires troubleshooting with a schematic and an oscilloscope which is beyond the scope of this paper. I would suggest that if you get to this point you might consider a used unit.

Testing:

1. I performed some limited testing on the unit. This involves connecting the unit and the battery cable. Then turning the key to the "on" position to see if the warning lights come on, then start the car and see if all the warning lights go out except for the "stop lamp". If it does, press the brake and the lamp should go out.

2. If it does, pull up the parking brake to see if the warning light and (!) indicator illuminate. Release the brake and both lights should go out. Try this several times randomly.

3. If the unit can perform these functions correctly then the sensor inputs are being compared and the microcontroller is executing the code that makes the system work.

4. If the unit is working correctly, but when you drive the car it begins to go crazy, then most likely you have a loose solder joint that is intermittently contacting due to vibration. Re-inspect to find the bad joint and re-flow.

Assembly:

1. If the faceplate is not attached; secure it to the circuit boards with the appropriate screws. Make sure to get the faceplate back on the correct way that you recorded earlier.

2. Orient the assembly correctly and align the circuit boards to the grooves in the enclosure. Once the circuit boards are in their grooves, slide the assembly back together. I crimped only two tabs back down to hold the assembly in the enclosure to make it easier to open if needed.

3. Attach the enclosure to the dead pedal with the 3 nuts and washers.

4. Clean the contacts of the main connector and harness plugs with alcohol and insert the harness plugs into their respective connectors.

5. Position the dead pedal in place and secure with the screw.

6. Reconnect the battery cable and check functionality.

Time for that cold beer!!!