

Turbo Express Capacitor Replacement Kit Installation Guide

Thank you for your purchase of a Turbo Express capacitor replacement kit from Mortoff Games. We appreciate your order and hope to have the chance to serve you again in the future. This guide is designed to take you through the steps involved in the installation of your repair part; if you have any questions please contact us at CustomerService@MortoffGames.com

Thing you will need

- Turbo Express capacitor replacement kit
- Small Philips head screw driver
- Small flat head screw driver
- Soldering iron
- Solder
- Soldering braid
- Fume hood
- Patience
- A clean work area where small parts will not get lost
- About 1.5-2hrs of spare time

Safety

This repair requires hours of extensive solder and unsoldering. Much of the old solder is composed of lead and other harmful toxins. In addition the board is covered in plastic and glue that will be melted during this repair. All of these substances should not be inhaled. Throughout this repair you should use a fume hood to protect yourself from the dangers associated with breathing these fumes in. Please do not try to do these repairs without one. We are more than happy to provide you with a full refund on this repair kit rather than have you endanger yourself because you lack the proper protection equipment.

Soldering Skills Needed

This repair requires extensive soldering skills and should not be attempted by a novice. You are more likely to damage the system if you don't have the proper skills. We recommend that if you are not completely comfortable with your soldering skills you return this repair kit for a full refund at this time.

Patience

This repair requires roughly one and a half to two hours of intensive work. If you start to get tired we recommend that you stop and come back to the work at a difference time. Attention to detail is an absolute must during this repair.

Index of Capacitors in Kit

In case you are interested here is an index of all of the capacitors include in this repair kit. As you may notice the capacitors are packaged by type and labeled accordingly for ease of usage. If you ever find what you need more of a particular type of capacitor please contact us at CustomerService@MortoffGames.com we are more than happy to sell them individually.

Ratings	Quantity
100uf 16V	3
33uf 6.3V ¹	2
100uf 6.3V ²	6
4.7uf 35V	1
4.7uf 50V	1
22uf 35V	1
470uf 6.3V	1
10uf 16V	1
47uf 6.3V	1
22uf 6.3V ³	1

¹ Substitution for 33uf 6V surface mount capacitors

² Substitution for 100uf 6.3V surface mount capacitors

³ Substitution for 22uf 6V surface mount capacitors

Index of Part Numbers and their Associated Capacitor

When looking at the circuit board you will notice there is a number next to each capacitor that identifies its part number. The part number will always start with the letter “C”. This is an index of those part numbers and their associated capacitors.

Part Number	Specifications	Mounting Type
CC100	100uf 16V	Surface mount
CC101	33uf 6V	Surface mount
CC102	33uf 6V	Surface mount
CC103	100uf 6V	Surface mount
CC104	100uf 6V	Surface mount
CC501	4.7uf 35V	Surface mount
CC502	4.7uf 50V	Surface mount
CC503	22uf 35V	Surface mount
CC504	100uf 6V	Surface mount
CC505	100uf 6V	Surface mount
CC700	100uf 6V	Surface mount
CC702	470uf 6.3V	Through hole
CC703 ⁴	100uf 6V	Surface mount
CC704	10uf 16V	Surface mount
CC800	47uf 6.3V	Through hole
CC900	100uf 16V	Surface mount
CC901	22uf 6v	Surface mount
CC500	100uf 16V	Surface mount

Note

While examining the circuit board you will notice a variety of small parts that also have numbers that start with C that are not on the above list. While these are indeed capacitors, they are not aluminum electrolytic capacitors and therefore do not need to be replaced. While they can fail doing so usually requires a significant surge through the board that would fire the circuit board. So you can effectively not worry about them for the purposes of this repair.

⁴ A discussion on how to access this capacitor is on page eleven.

Using a Capacitor Checker

While you can certainly change out every capacitor on the circuit board this is both a tiresome and unnecessary action. While you might have heard or read otherwise on the internet if a capacitor is working it does not need to be replaced if it is working within factory guidelines.

There are devices that allow you to check capacitors to determine if they are operating within appropriate parameters. We use the CapAnalyzer 88A Series II. It is very simple and operator friendly; however it does cost over \$200. This is a great deal of money; although if you are doing regular electronics work it is a great tool to add to your collection along with a voltmeter and oscilloscope.

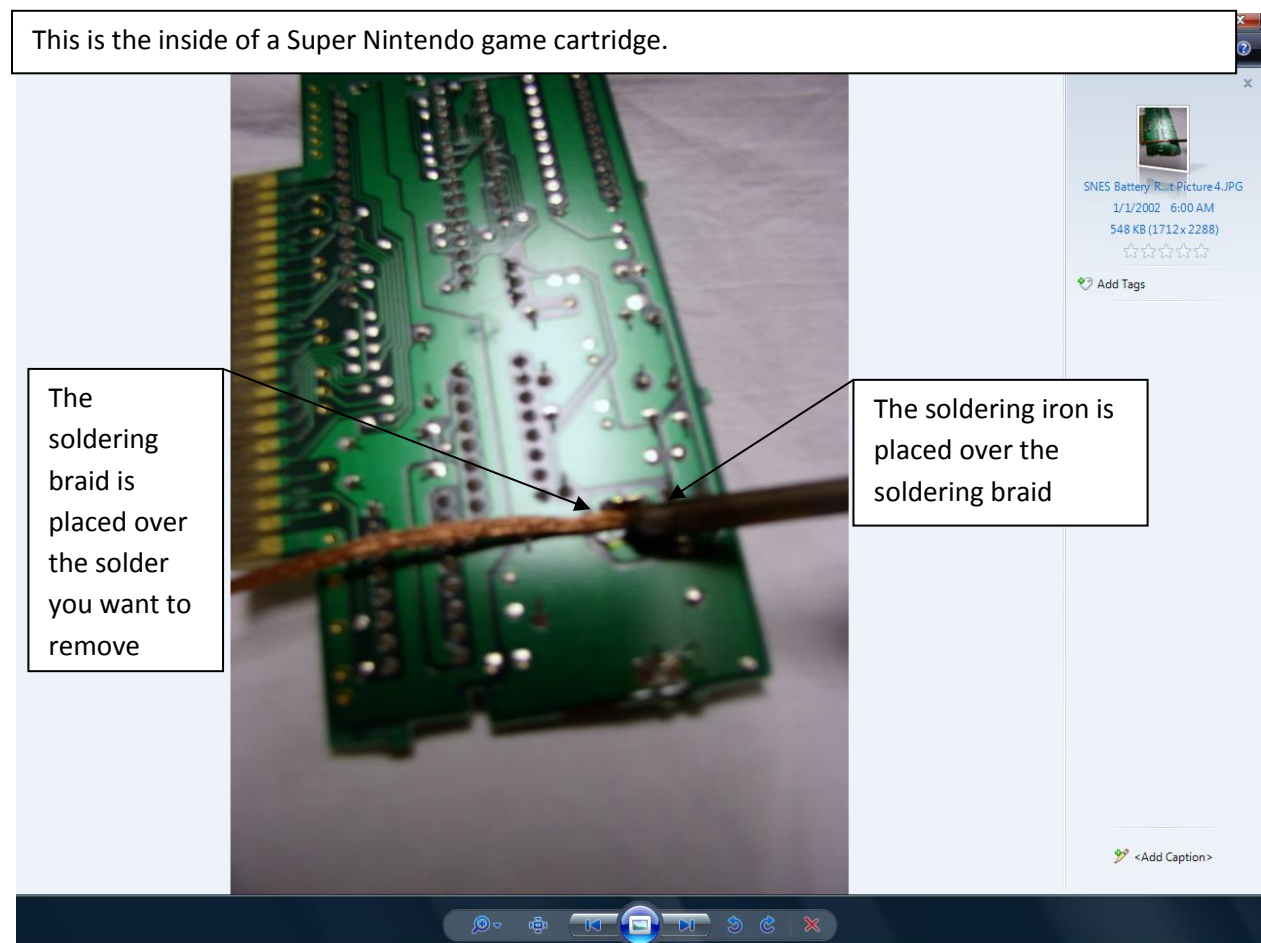
There are many capacitor analyzers on the market, although most cost several hundred dollars. If you do purchase one, we recommend getting one that can check capacitors in circuit. This allows you to check them each capacitor without having to unsolder it.

Soldering Techniques:

In order to solder and unsolder correctly you will need a soldering iron, solder and soldering braid. Once you have these items it is safe to proceed forward. For the duration of this project it is not recommended that you use a cold heat or any other instantaneous heating soldering gun, since these guns use an electrical current to melt the solder. Passing a strong electrical current through your games is not recommended and as such should be avoided. We recommend that you use a typical soldering gun, the type that you have to plug in and wait to heat up. In addition it is recommended that you set your soldering iron to 30watts for the duration of this project.

Unsoldering:

Correctly unsoldering a joint is rather easy once you get the hang of it. In order to unsolder a joint place soldering braid over the solder you wish to remove and then place the soldering iron over the soldering braid. The soldering iron will heat the braid and in turn the solder will liquefy, which will be sucked up by the braid. Please see the picture below.



Picture Introduction: Proper usage of solder braid

Although it might take a little while to completely remove all of the solder, patience and persistence will pay off in this case. Every 10-15 seconds remove the soldering braid and check to see if the solder has been fully removed. As soldering braid takes up solder periodically cut off these used sections as needed.

Soldering:

Now that the solder has been removed you can now remove the object that the solder was holding in place and you are now ready to solder something new into place. During this project it is not safe to use excessive soldering material as bridging between joints is very easy due to their close proximity to each other.

The two most important things to keep in mind are:

- 1) Never allow patches of solder to overlap or touch, doing so creates a short, thereby rendering the circuit inoperable.
- 2) Make sure to use enough solder to securely attach whatever it is you are soldering, do not be afraid to test the joint out.

Keeping these items in mind lets continue with our demonstration. To apply the solder take it and place it over the soldering joint and then lightly place the soldering iron over the solder. This is just like unsoldering, although this time you are soldering and not unsoldering. This part is a little tricky when you first start and is hard to describe with words alone. It is recommended that you test out melting solder first to get an idea of how it behaves.

One ideal exercise you might want to try is to attempt to solder together two pieces of wire. Take two pieces of wire, strip the ends, twist the ends together and then practice applying solder over this twisted joint. During the course of this project if you run into trouble remember you can always back track and remove the solder and try again, using the soldering braid. Soldering braid and solder are very cheap and as such are worth playing around with to get comfortable with before you go ahead and install your replacement part.

Step One:

To start please turn over the unit and remove the battery cover. Then locate the six Philips head casing screws as seen in picture one below.

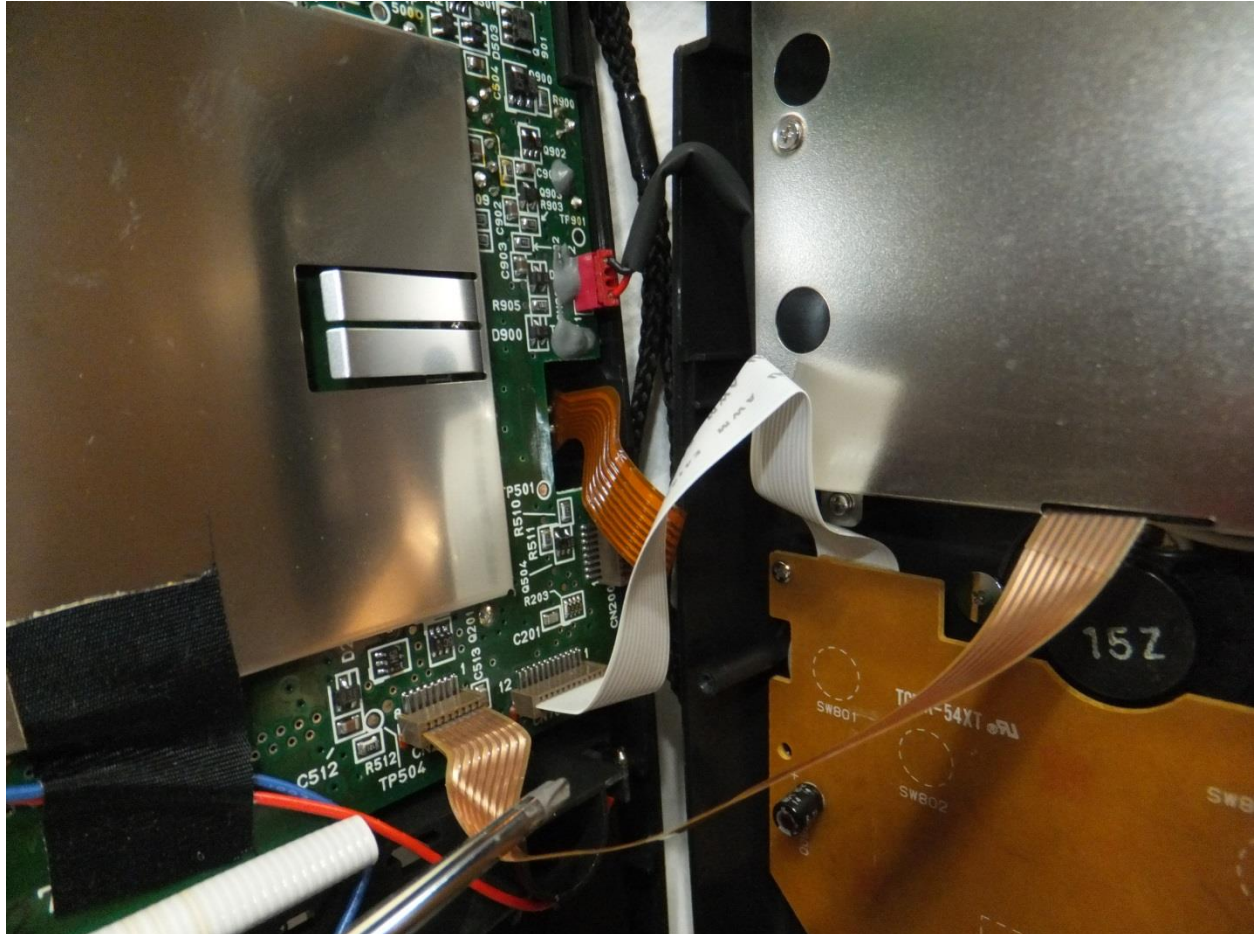


Picture One: Back side of the Turbo Express

Once you have located them please unscrew the screws and remove the back casing. Once completed please proceed to step two.

Step Two:

Once the back casing is removed you will notice this mess of wires and cables as seen in picture two below, yikes! Carefully disconnect all of the cables



Picture Two: Mess of wire and cables

Once the two halves have been separated please proceed to step three.

Step Three:

Please unscrew the Philips head screw holding down the front circuit board as seen in picture three below.



Picture Three: Front circuit board

Once the front circuit board has been unscrewed it should flip forward allowing you access to both sides of the circuit board. Please proceed to step four.

Step Four:

Now that the front part is disassembled it is time to work on the back part. Please locate the three Philips head screws seen in picture four below and unscrew them.

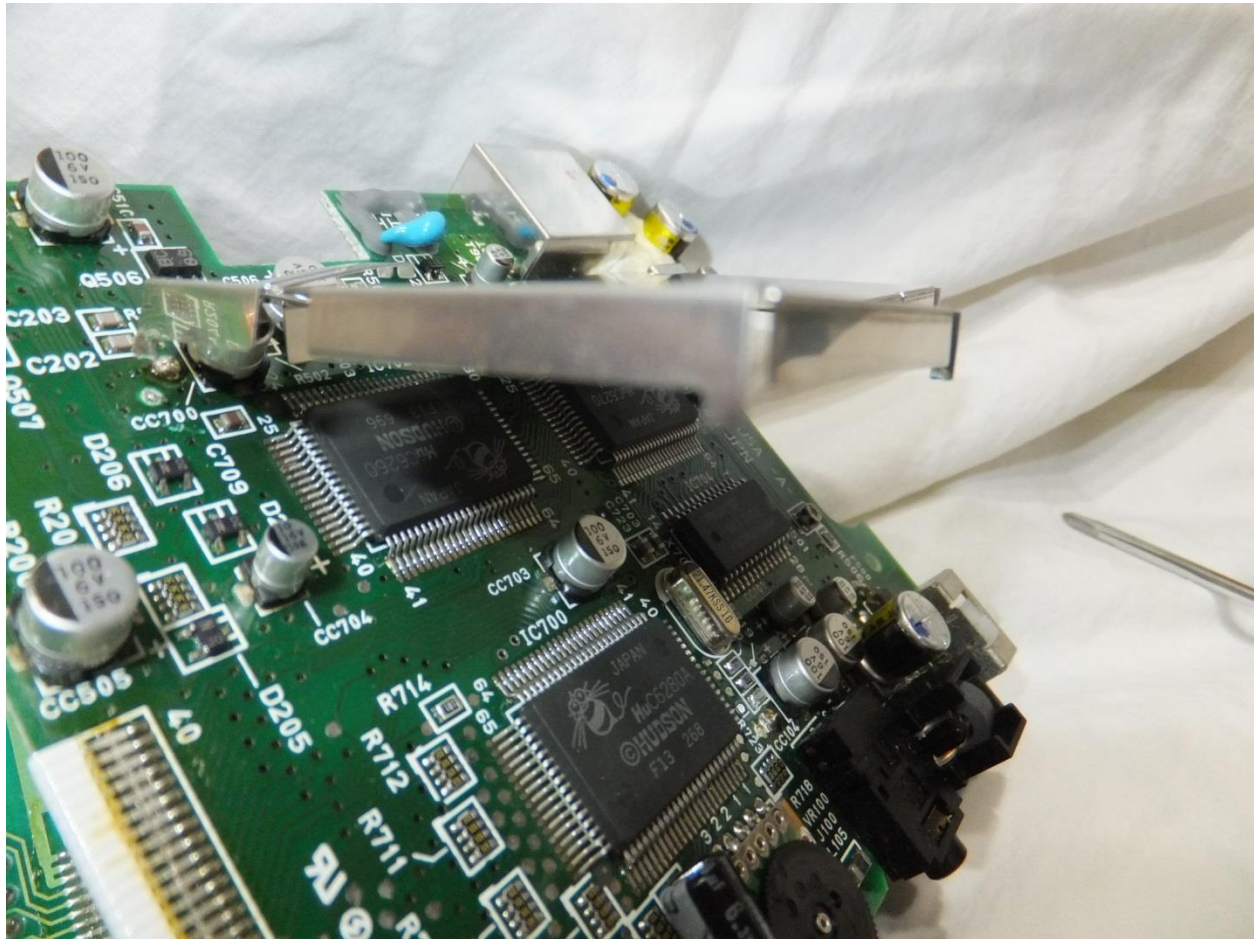


Picture Four: Back circuit board

Once this is finished you are ready to get to work, although a quick discussion on how to access C703 is presented next.

C703: How to Access

Viewing the picture below you will notice that there is a hidden capacitor underneath the RF shield on the front side of the front circuit board. This capacitor can be reached by cutting away or unsoldering the RF shield; however this might now be needed and we recommend against routinely attempting to access this capacitor unless replacing the other more conveniently located capacitors fails to solve your problem.



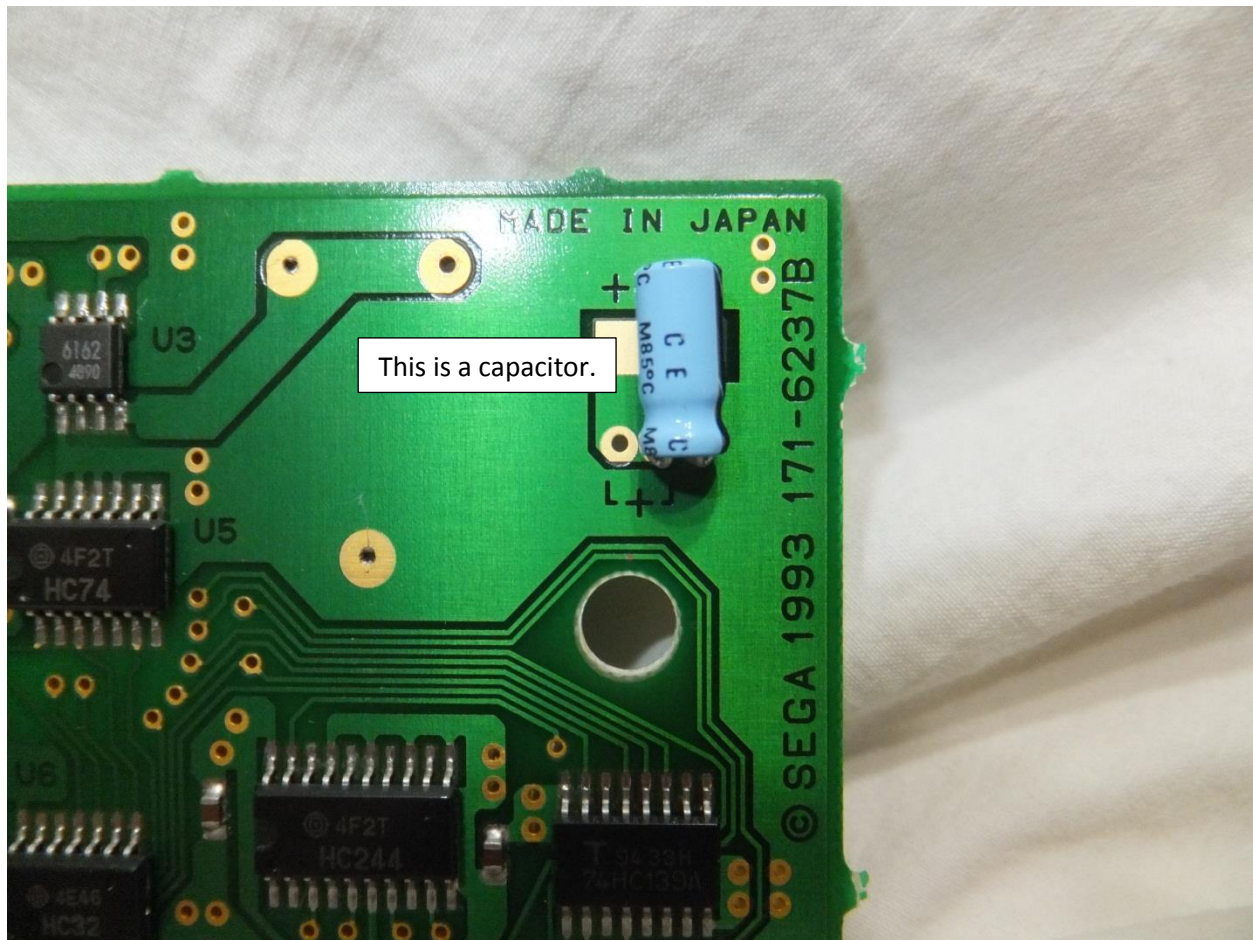
Picture Five: RF shield partially removed to reveal the “hidden” CC703 capacitor

Now that the system is fully disassembled you are ready to start replacing the capacitors; however it is important for us to familiarize you with the basics of how capacitors work.

An Introduction to Capacitors

Before we jump into the capacitor replacement it's important to understand the basics first. A capacitor is used to store electrical energy. It has two listed measurements microfarads (μF) and voltage (V). You will notice when you look at your replacements capacitor it has the microfarads and voltage listed on it. It is important that you replace each capacitor with the same ratings as the original for optimal performance.

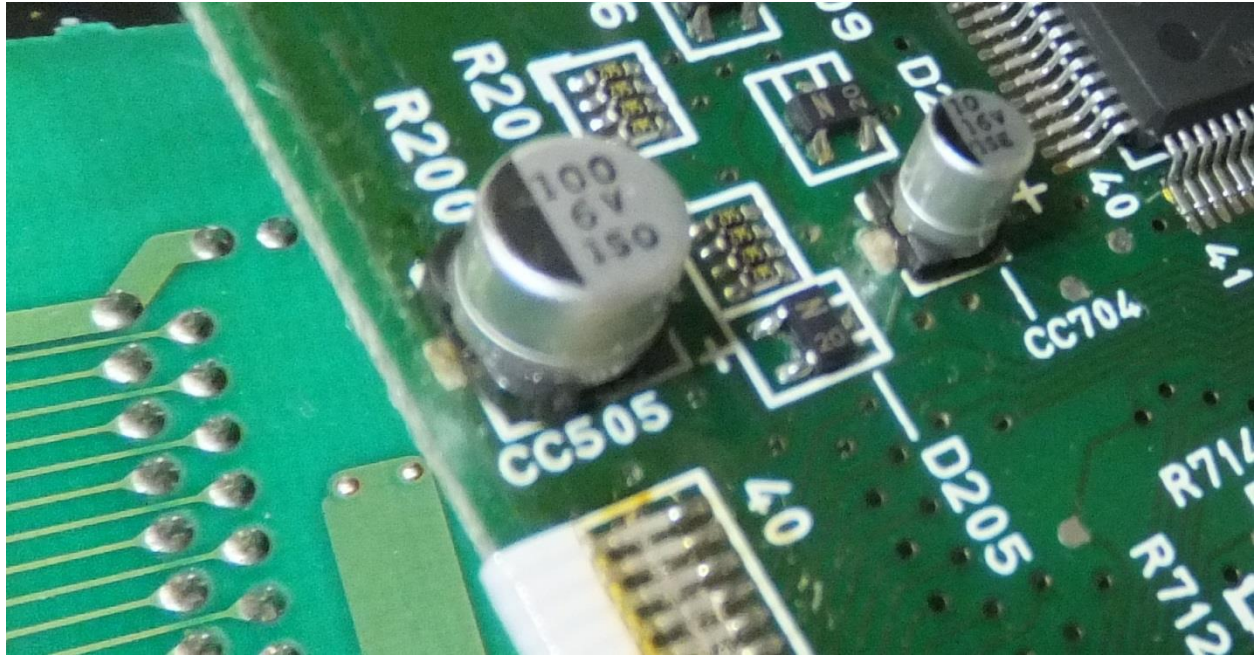
There are two types of aluminum electrolytic capacitors used by the Turbo Express that vary on the way they mount to the circuit board.



Picture Six: Sample capacitor, radial mount

The capacitor seen in picture six above features a radial mounting, hence called because it has legs that originate from the capacitor and then fit into holes on the circuit board, which are then soldered into place.

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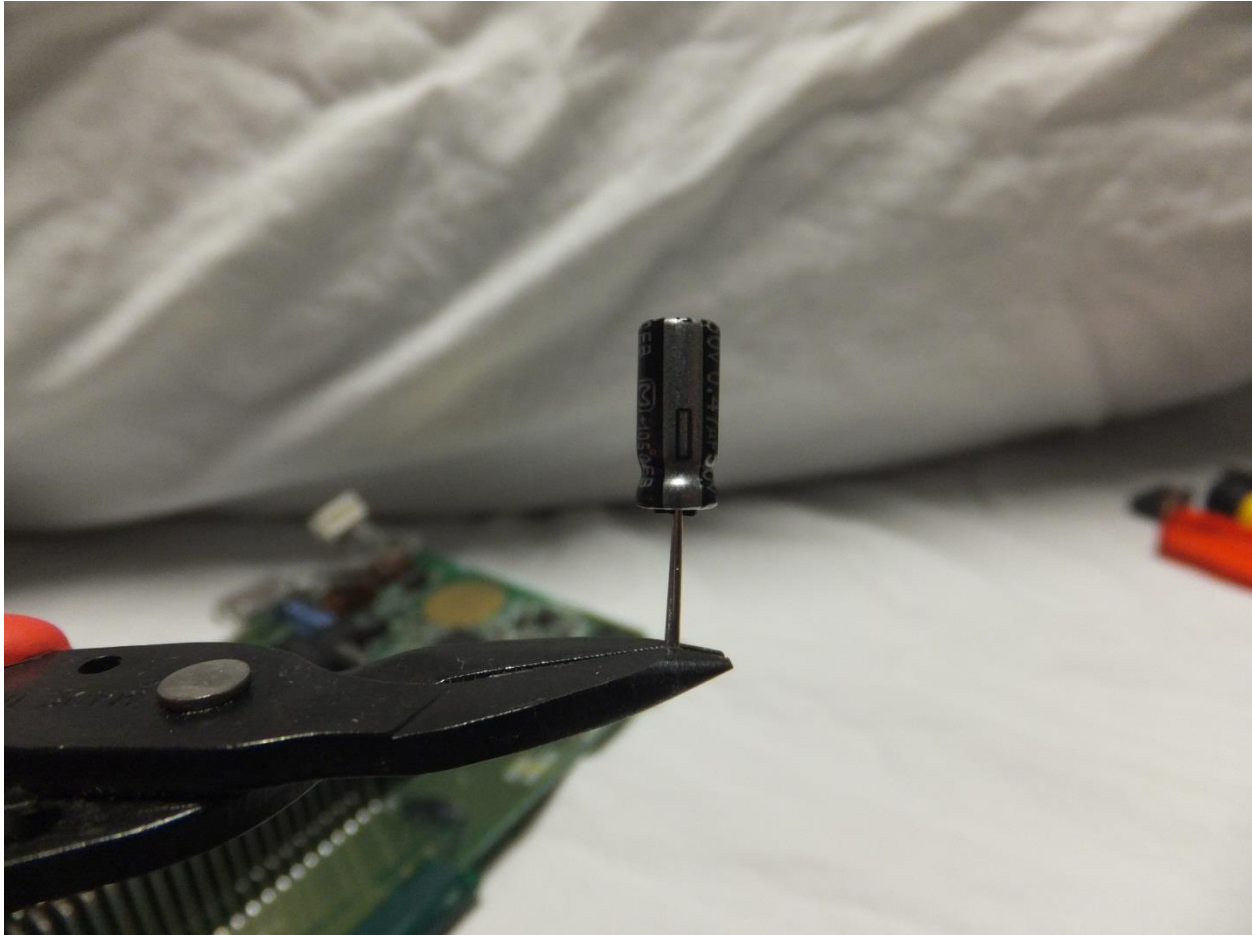
Picture Seven: Sample capacitor, surface mount

The capacitor seen in picture seven above is surface mounted since its legs are soldered directly to the surface of the circuit board.

Each type of capacitor has a negative and positive lead. It is very important to make sure that you don't get these backwards. The positive terminal should be soldered to the positive terminal on the circuit board and the negative terminal to the negative terminal on the circuit board. Fortunately the positive terminal is marked on the circuit board; however the terminals on the capacitor are not marked. This is discussed on the next page.

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Most capacitors do not have the positive and negative terminals marked with symbols, but instead the negative terminal is defined by the terminal that originates from the part of the capacitor that has a strip running down it. This strip can vary in color.



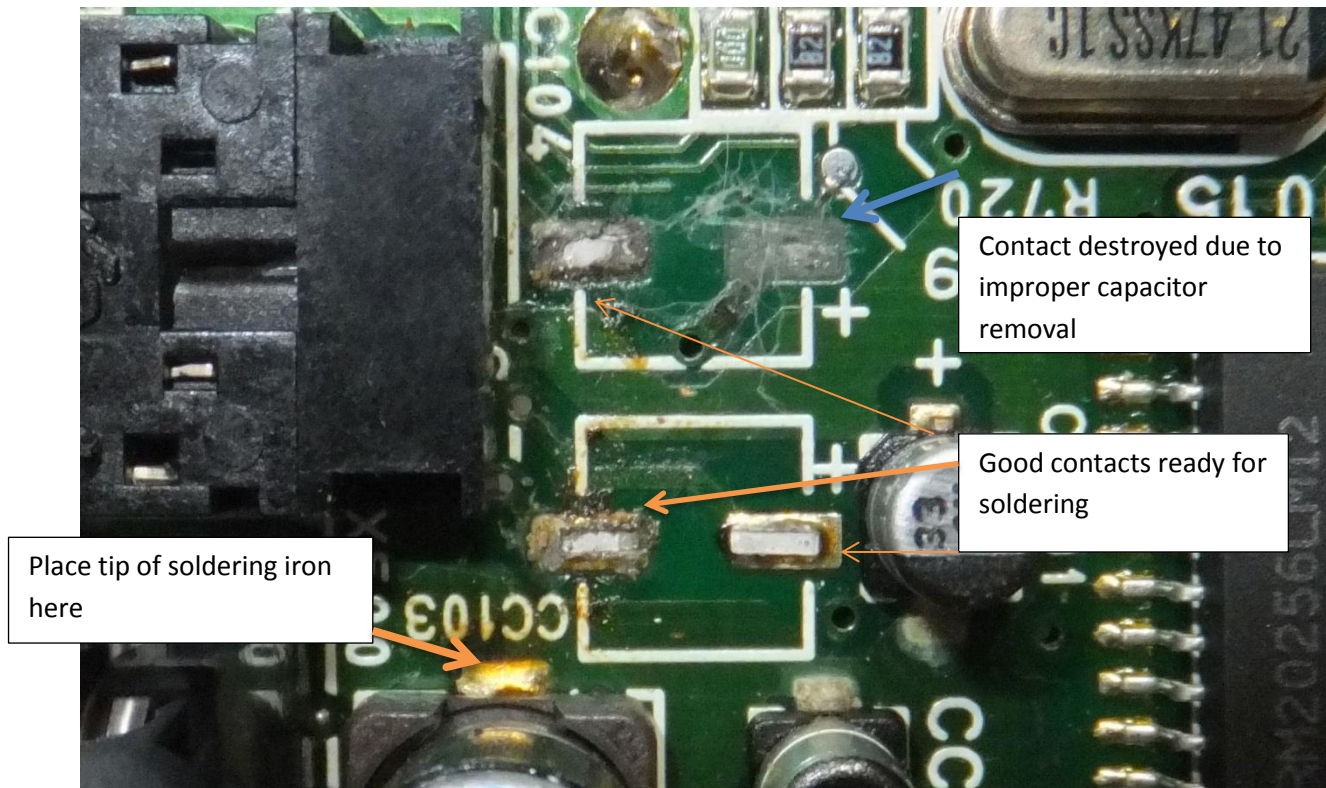
Picture Eight: Radial mount capacitor negative terminal

In this case the strip is silver in color. Please don't be fooled as the strip can be different colors. Just remember that the strip always denotes the negative terminal of the capacitor. The same is true for the surface mount capacitors. If you look back at picture seven. The negative terminal is marked by the side of the capacitor with the black half-circle.

Now that you have a general understanding of what capacitors are and how to properly identify their microfarad and voltage rating it is time to start replacing them.

Step Five:

Now that you are familiar with the two types of aluminum electrolytic capacitors in the system it is time to start replacing them; however this is tricky. Removing the surface mount capacitors requires some patience and a delicate touch.



Picture Nine: Improper removal of a surface mounting capacitor

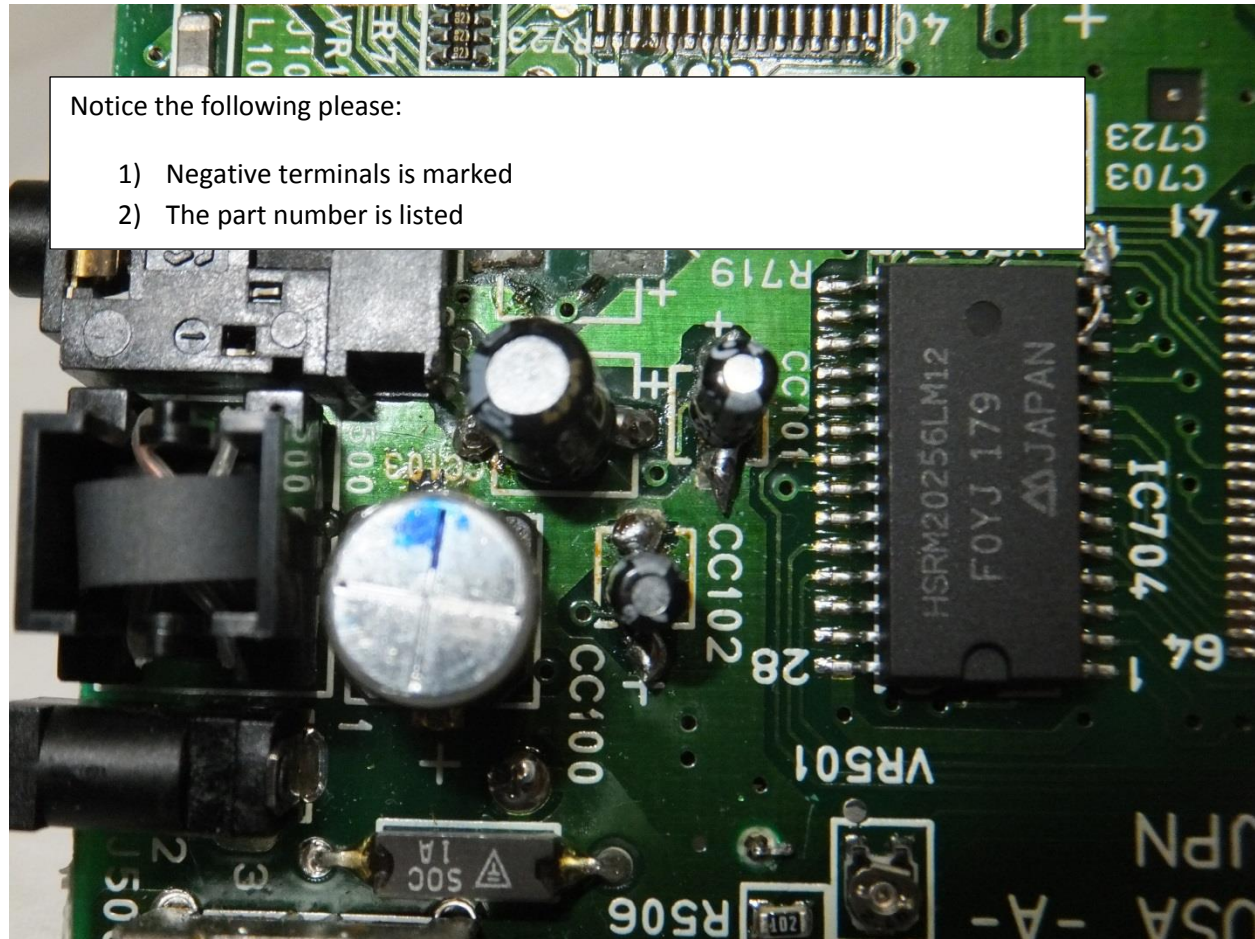
Please study picture nine for a moment and notice that CC104 and CC103 have been removed. Do you notice how the contact pointed out by the blue arrow looks different than the other three? This is because it has been damaged by improper removal of the CC104 capacitor and is now ruined. While it is hypothetically possible that this can be repaired in most cases this unit may not be salvageable.

Please, please use caution and don't let this happen! Using our strategies this can be avoided.

- 1) Do not pry the old capacitors off ever.
- 2) Use a soldering iron with a very narrow tip to unsolder the surface mount capacitors. The proper place to unsolder is shown in picture nine above. In this fashion the capacitor can be safely peeled off the board and the contacts can be preserved.

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As seen in picture ten below CC103, CC101 and CC102 have been replaced. This image is worth studying as it shows how cleanly these replacement capacitors can be installed if care is taken.



Picture Ten: Clean installation of capacitors

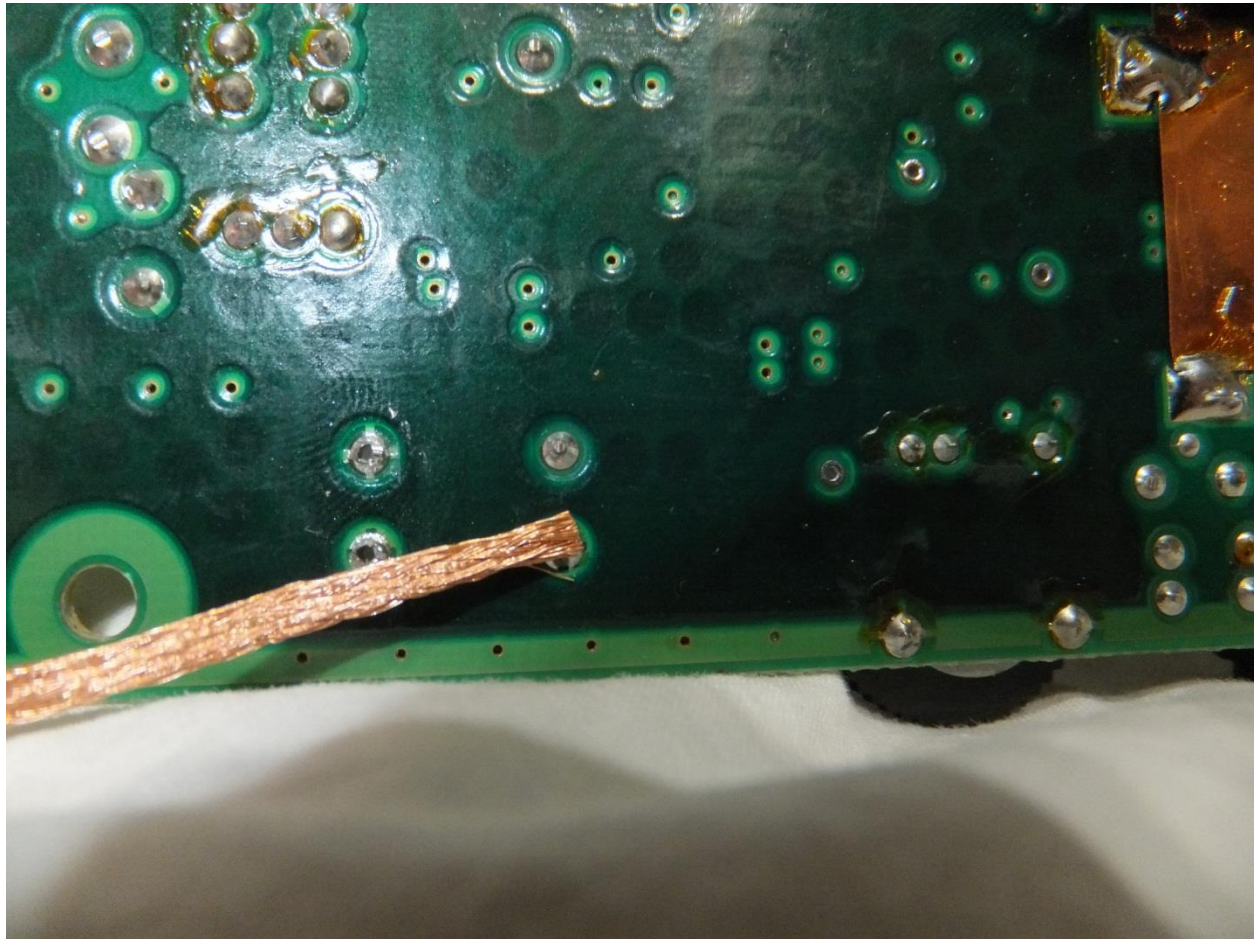
We recommend that you start by cutting the leads of the replacement capacitor very short, about 2-3mm in length. Then apply a small amount of solder to the negative terminal. Once done place the negative lead of the capacitor onto the mound of solder and re-melt the solder along the lead to sink into the mount.

After the terminal lead is securely attached then using a set of small pliers bend the positive lead so it sits directly over the positive contact on the circuit board and solder it into place. Once finished check the joints for strength.

The strategies for replacing the radial mounting capacitors are somewhat different and discussed next.

Radial Mounting Capacitors Installation

To start please unsolder the capacitor of interest. We recommend the following strategy.



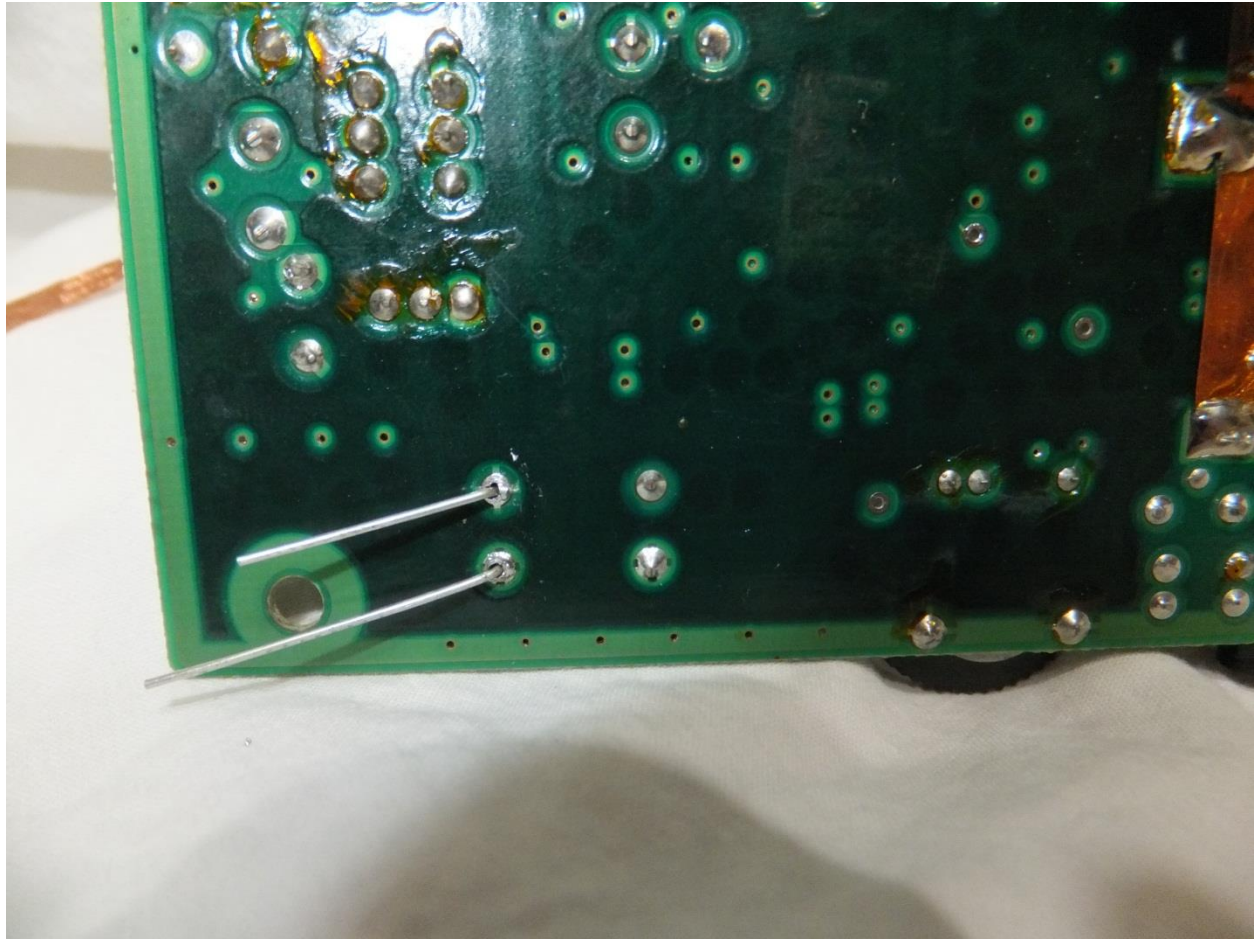
Picture Eleven: Proper usage of soldering braid

Place the soldering braid over the solder joint and then heat the joint with your soldering iron. The braid will suck up the solder and free the lead. You can also apply a small amount of traction on the lead by grasping the lead from the other side with a set of needle nose pliers and pulling if needed.

Once the leads are unsoldered please proceed to the next page.

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Next you need to solder the replacement capacitor into place. Remember negative to negative and positive to positive. We recommend the following strategy.



Picture Twelve: Lead soldering

Insert the leads and then bend them at a ninety degree angle. Then cut the leads down to the desired length. Finally solder the leads into place.

Please continue replacing the capacitors as needed. Here are some very important points not to forget.

- 1) Make sure you do not bridge any terminals
- 2) Make sure the leads of the capacitors don't touch each other.
- 3) Don't be afraid to bend the capacitors leads. You will have to flatten them anyways to get the casing to close.

Once you are finished please reassembly your system and enjoy your working unit; however if everything is not working correctly after it is back together please see our troubleshooting section at the end of this guide.

Troubleshooting Section

We are sorry to hear that you ran into complications from your repair. Unfortunately this particular repair is difficult to troubleshoot due to the complexity of the repair job, although here are some general guidelines.

- 1) Make sure that the terminals of each capacitor are firmly soldered in place.
- 2) Make sure that none of the terminals are bridge with solder
- 3) Make sure that none of the leads of the capacitors touch each other.

We do apologize that we can't be more helpful than this.