

Williams Star Trek: The Next Generation PopCap Installation

The following document walk you through the installation of Pinball-Mods.com's [STNG Popcaps](#) on a William Star Trek: The Next Generation Pinball machine. This upgrade is a bolt-on modification which requires no irreversible changes to your pinball machine. We recommend you read this document in its entirety prior to purchasing the product; then print it for your reference during the actual installation of the Pop Bumper Caps on your machine.

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Tools/Materials Needed:

- Kit Contents
- Philips Screw driver
- ¼” nut driver
- Included or optional LEDs such as:
 - Comet Pinball: 4SMD LEDs
 - Comet Pinball: 11SMD PopBumper LEDs
 - BriteMods.com BriteCaps™ [EVO Caps](#) (see Appendix A)

Optional Tools/Materials needed for Appendix A (EVO Caps):

- A 5V [bench power supply](#) or equivalent
- De-soldering equipment (one or more of the following):
 - [SMD Soldering tweezers](#)
 - or [Flush-Cut Wire Cutters](#)
 - and some [Solder Wick](#)
- A soldering iron with solder
- [SMT tweezers](#)
- Some hookup wire to bridge traces on cut EVO cap. Suggestion: [Red Kynar™ Wire](#)
- A Dremel w/ [reinforced cutoff disc](#)
- [Exacto-type knife](#)
- Black “[Sharpie](#)”
- An insulating compound such as: Acrylic [Conformal Coating](#), [liquid electrical tape](#), or [3M 88 Electrical Tape](#)
- At Least 19 Purple SMT LEDs from Kingbright: AA3528VRVFS/A

The process to install this kit is fairly simple and should only take a couple of hours to complete. The kit comes with everything you need to install these pop bumper caps in your machine; however, for best results you may want to consider running BriteMods EVO Caps instead of the included LEDs. The procedure for modifying EVO caps is included as Appendix A; which includes instructions for “cutting down” an EVO cap for use under the Beta Ramp of STNG. There are also instructions for converting the Natural White LEDs on the underside of the LEDs to Purple. We recommend you preform Appendix A (If desired – it is optional) prior to completing the installation in the main section of this document.

STNG PopCap Install (step by step)

- 1) Remove the lockdown bar and glass on your machine. Pull the playfield into it’s service position. I usually work from the left of my machine but you’ll probably want enough room on both sides so that you can work in the pop bumper area.

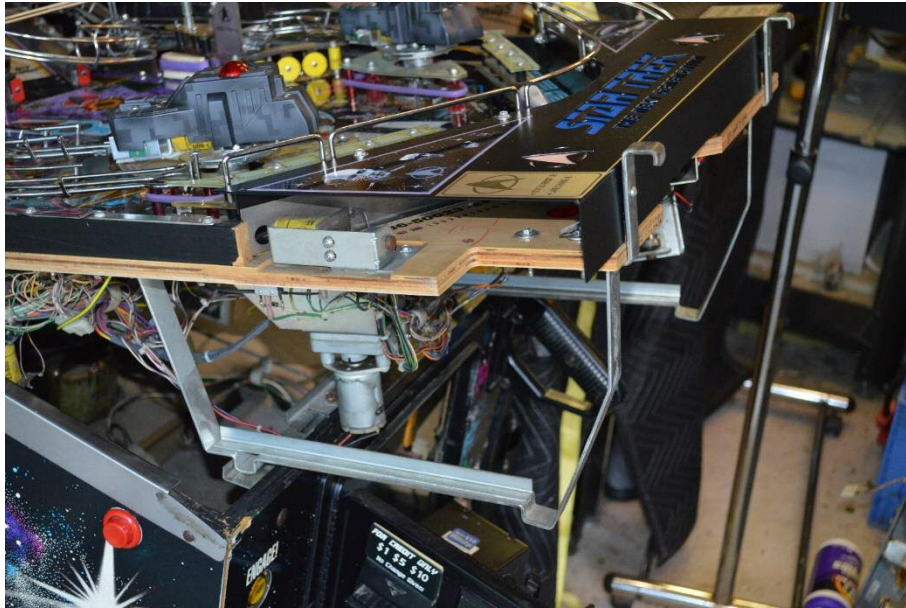


Figure 0.1 Playfield at Service position

- 2) It may be possible to install the popcap kit without removing the beta ramp; however, The author finds it a lot easier to work in the pop bumper area with the beta ramp free. The next several steps will show you how to remove the beta ramp on your machine. Locate the

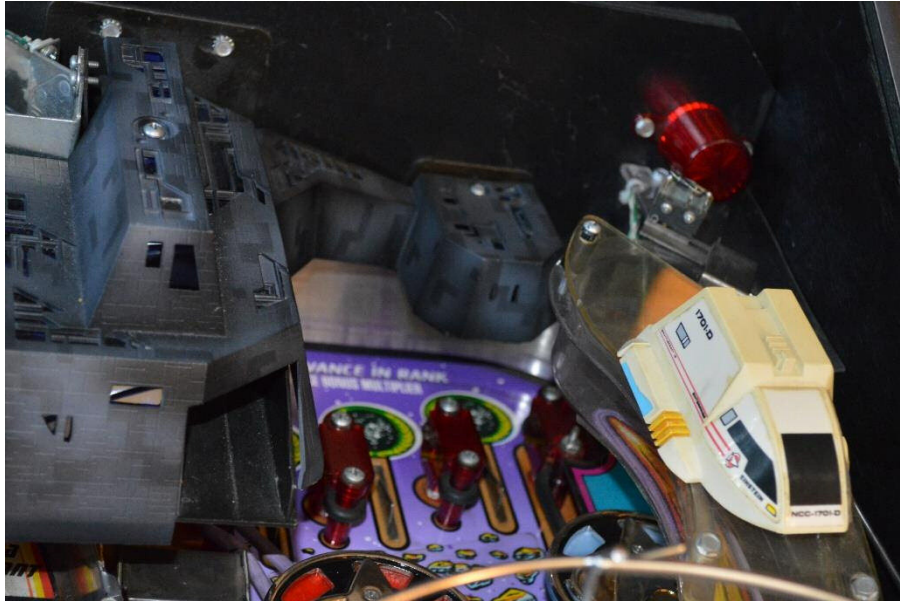


Figure 0.2 Remove Red Light dome and Flasher bulb

Red light dome which has screw tabs on the right corner of the back box. Remove the two hex head wood screws to free the light dome. Remove the flasher lamp and set all four items aside for re-assembly.

- 3) Remove the two hex head machine screws holding the beta ramp to the backboard. Set aside for reassembly.



Figure 0.3 Remove machine screws holding beta ramp to backboard

- 4) Remove the two wood screws holding the beta ramp to the playfield, set aside.



Figure 0.4 Remove ramp wood screws holding ramp to PF

- 5) The Author likes to have the beta ramp completely free; however, it's possible you might be able to wiggle the ramp free at this point. I find it's easier to go ahead and remove the beta ramp return wireform so that ramp is completely free. To do this locate the two wood screws holding the wireform to the PF and remove them with a long reach magnetic screw driver.

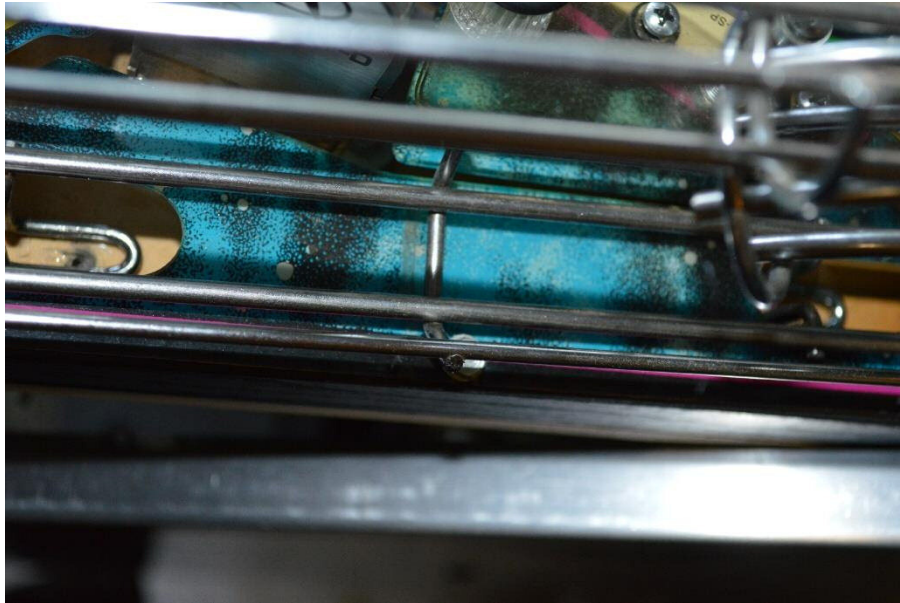


Figure 0.5 Remove beta wireform from PF

- 6) With the wireform removed from the beta ramp; it becomes very easy to position the ramp out of the way while you work in the popbumper area.

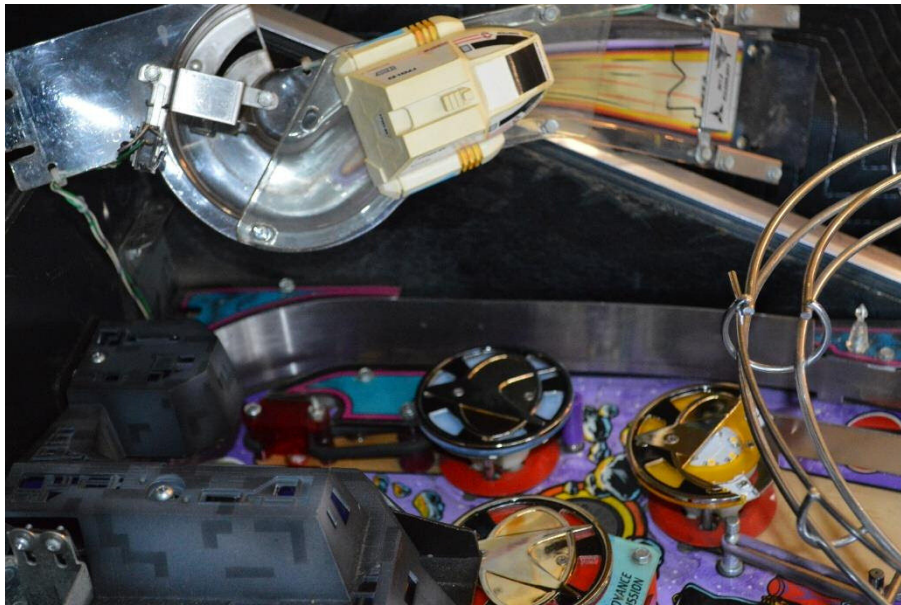


Figure 0.7 Leave switch harness connected; but position ramp out of way

I do not disconnect the ramp's switch harness from under the PF... Instead; I just prop it against the side cabinet; or usually dangle it over the back of the backboard. Just remember to put the ramp back in position if you are going to slide the PF back into the game. Additionally; if you plan on lifting the PF into the upright position; I recommend you put the ramp back in position and put one of the machine screws from step 3 in place so the ramp doesn't "fall out" when you are positioning the PF.



Figure 0.6 Remove Stock Caps, light bulbs, and screws

- 7) Next, remove the stock popcaps and light bulbs from the pop bumper. You won't be using any of the stock caps and parts; so put them in a ziplock bag and store them someplace safe if you intend to reverse the mod at some point.

- 8) Install your LEDs in the bulb socket. For uniform colors install as indicated in the picture below.



Figure 0.9 Install Kit LEDs (4-SMT)



Figure 0.10 Install Kit LEDs (11-SMT)



Figure 0.8 Install EVO LEDs (from Appendix A)

For the EVO LEDs; make sure K2 is horizontal pointing to the right. K1 should be at ~45 degrees. Line up the screw holes of the pop bumper body to the screw holes of the EVO.

- 9) Stack the UnderCap under the PopCap and feed one of the #4-40 pointed screws thru one of the holes of the popcap. Orientation of the Undercap matters. The Trench always faces

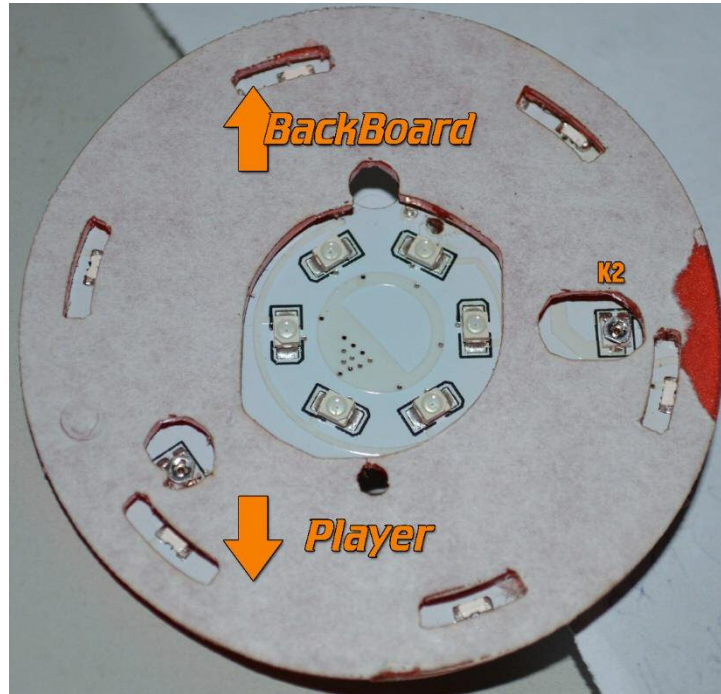


Figure 0.12 UnderCap Orientation

down toward the PF (or EVO cap). The Trench is there to provide a keepout zone for the outside LED ring on the EVO caps and It serves no purpose on the 4SMD or 11SMD installs;

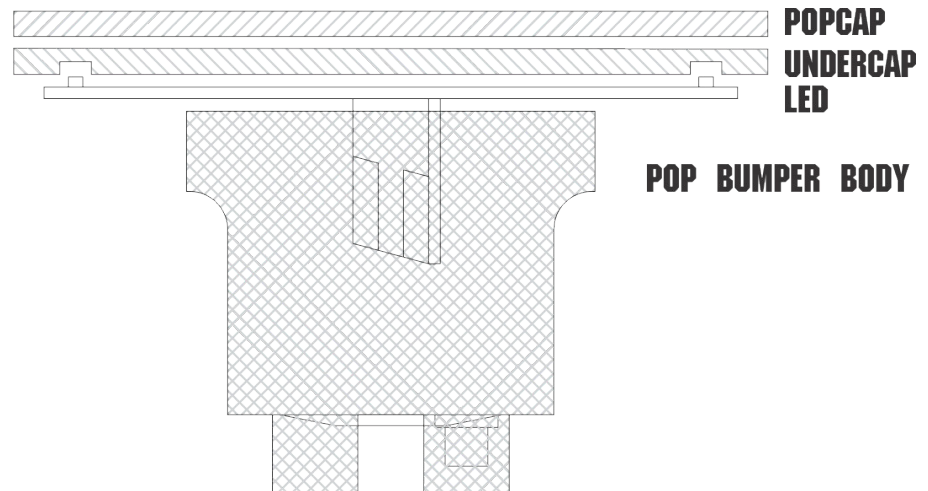


Figure 0.11 Product Stackup

but it should still face down toward the PF for aesthetics.
On 4SMD installs; it should be fairly easy to line up the popcap, undercap, and popbumper body since the LED is does not need to be bolted to the body.

On 11SMD installs; it will probably be the most difficult to line up as the LED assembly needs to also bolt to the same screw holes. I don't have any real advice, other than possibly drilling out the mounting holes on the 11SMD lap assembly with one size larger drill bit.

On EVO installs; it's fairly easy because the lamp socket in the popbumper body is fairly rigid and you can line up the holes. The Author recommends that you install the EVO first, center the holes over the pop bumper body's screw holes, then install the UnderCap on top of the



Figure 0.14 EVO UnderCap placement

EVO. This should make it easier to ensure the cap/EVO fits correctly and you have no clearance issues with the EVO's components.



Figure 0.13 Leave first screw slightly loose

Leave the first screw slightly loose so that you can line up the final screw hole.

- 10) Install the second #4-40 pointed screws thru the second hole. It might help to shine a flashlight thru the empty hole and line all 3 items up to the center of the holes. Ensure the



Figure 0.15 Tighten both screws

Undercap is flush against the the round side of the top PopCap. Tighten both screws snugly; keeping in mind it's only a plastic bumper body under the stack up. IE Monkey tight; not gorilla tight.

- 11) Repeat the installation procedure for the Right Jet Bumper. Installation should be the same as the Left Jet Bumper.

- 12) For the bottom Jet Bumper; use the special cut PopCap and Undercap. These caps are “cut down” to fit under the beta ramp; while still maintaining a complete look for the set. Note that the UnderCap has two screw holes while the top PopCap only has the one. The author finds it easiest to put the lower #4-40 screw in first with the Undercap.



Figure 0.17 Lower Screw First

Then, run the final top screw in and adjust the position of the top cap so it's flush with the UnderCap below (which was squared by the two screws).



Figure 0.16 Top screw last

This UnderCap provides small holes on both sides and some breakable plastic pegs. These

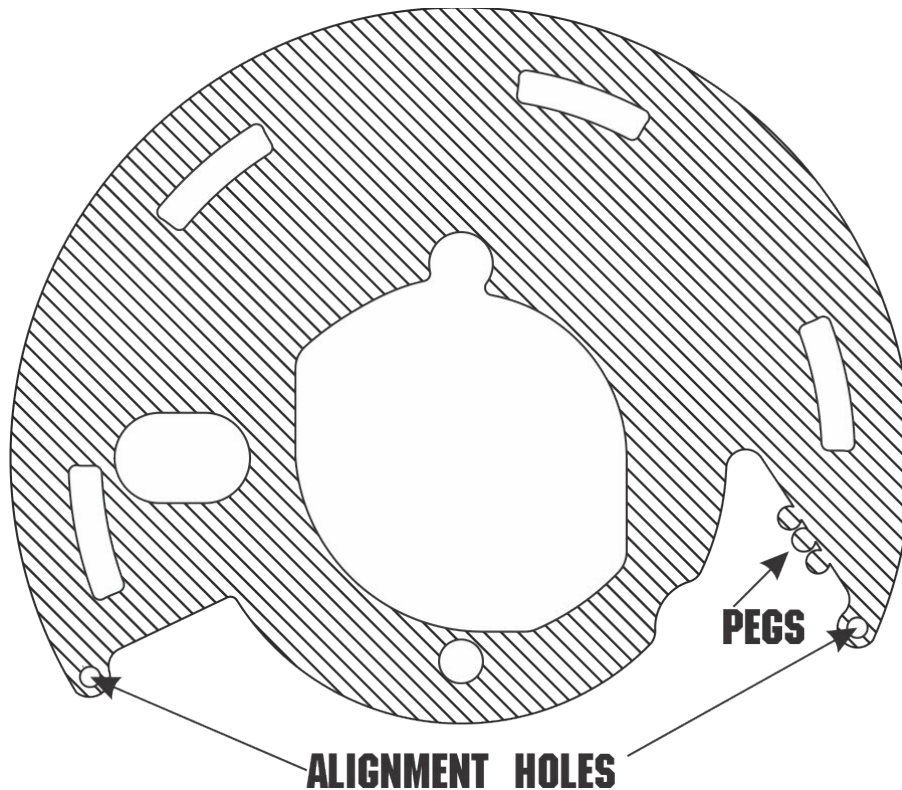


Figure 0.18 CutCap Alignment Features

pegs can be glued into the smaller holes to provide alignment pegs for the top popcap if you have issues with the cap rotating during play. The author hasn't seen this as an issue in his machine; so, it's not recommended at this time. If you want to use this feature; the pegs can be removed with needle nose pliers. Using two part Epoxy should secure the pegs in the holes.

- 13) At this point; the installation of the Popcaps is complete. You most likely installed some finger prints on the top of the mirrored surfaces of the top PopCaps, use a damp towel or microfiber cloth to remove them before you reassemble the beta ramp.
- 14) Reassemble beta ramp in reverse order re-installing the parts you removed.
- 15) Enjoy your new Popcaps with a couple of games.

A. BriteMods.com BriteCaps™ EVO Caps Modification

For best results; Pinball-Mods.com recommends using the BriteMods.com BriteCaps™ [BriteMods EVO Caps](#) (EVO) for use with these STNG Popcaps; however, because the EVOs are very expensive; Pinball-Mods.com cannot offer these for sale directly. In this appendix, we will “void the warranty” of the EVOs



so they will fit underneath the Beta Ramp and provide color matched purple lighting on the underside of the EVOs to match the STNG purple artwork in the pop bumper area. **Please note:** *Modifying the EVOs will absolutely render any warranty on the EVOs null and void; so, do at your own risk.*

Additionally; Pinball-Mods.com does not have any influence with BriteMods design team; as a result, these instructions are valid only for the currently available EVOs via PinballLife.com. BriteMods may revision the EVO PCB breaking compatibility with our UnderCaps. IF this occurs; Pinball-Mods.com should not be expected to update these instructions nor should we be expected provide updated Undercaps to fit their new design. We provide this instructions as a guideline only and you should expect to modify them as needed to fit your machine.

If you are installing the Uniform colored Undercaps (the acrylic colored discs provided with the kit); you are going to want 3 different colored EVOs. One Red, One Blue, and One Warm White EVO. We use Warm White for the yellow cap under the Beta ramp as yellow colored LEDs are generally “weaker” than their white counterparts. If you are planning to use all Purple or all Red Undercaps on your machine; you’ll want to get the EVO LED color which matches the Undercap you intend to install. IE all Red or all Purple EVOs. Optionally; if you don’t really know which color you want right now; could order all Warm White as that color would best match any color Undercap.

Before starting any modification to your EVO caps; we highly recommend you verify the functionality of the EVO caps before starting any work. This can be done in the machine or using a 5VDC bench power supply. The EVO PCBs are non-polarized as they have a Diode Bridge chip on the #555 wedge base. As such we recommend you verify that all the LEDs lite properly on the EVOs and that the product is 100% functional before applying the modifications below.

We will begin by modifying the Cap under the Beta ramp as it will require cutting the PCB so it will fit under the ramp and cap. This will be the most difficult part of this mod. Then we will follow up with a the “red” cap which recommends special modification of the Playfield LEDs in a certain pattern. Lastly; we’ll just swap the Playfield LEDs of the “blue” EVO to purple.

A.1 Beta Cap modification

The EVO cap which goes under the Beta Ramp (Bottom Jet Bumper designated 14 on pp **2-45** of the manual) is going to be the most difficult part of this mod. The Evo has to be “cut” to fit under the Beta ramp and it will require most of the tools suggested on Page 1. The tools suggested are only our recommendation; there are likely better tools out there for this job – but it’s what we used on our machine. On our machine; we are installing the Uniform color Undercaps which requires a Warm White EVO and the yellow “cut” Undercap. The pictures below will show us modifying the Warm White EVO; but the process should be the same for the Purple or Red EVOs you may be using.

1. Once you have confirmed the EVO LEDs light properly; locate the “cut” Undercap from your kit.

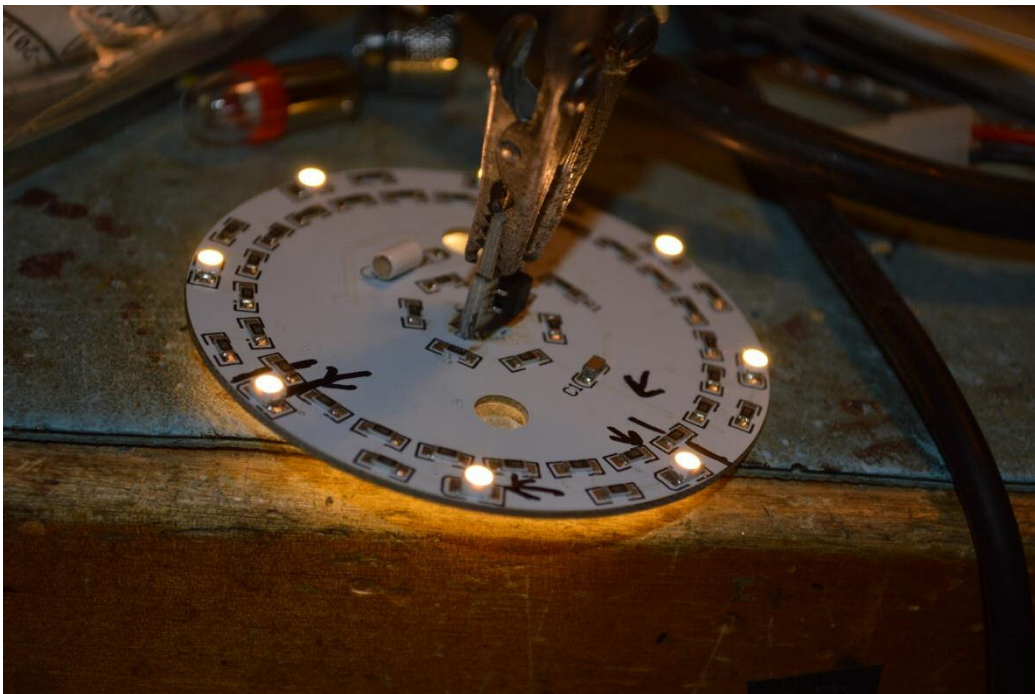


Figure A.1.19 Test EVO before modding

You will use this as a template to mark the “cut” lines you’ll need to do on the EVO. Position the cut cap so the outer ring LEDs of the EVO fit within the cut trench on the Cut cap. The Undercap should set flush with the top surface of the EVO due to that trench. The K2 and K1 variable resistors should be positioned as shown so they utilize the keepout zones in the Undercap. Make sure the “center” the screw holes between the Undercap and the EVO.

- Using a black sharpie; create a cut template on the top surface as pictured below. Note that you want “cut” in the center of the led to the right of K1’s variable resistor and meet near the curved junction made for K1. You’ll want to cut between the two LEDs as shown on the right.

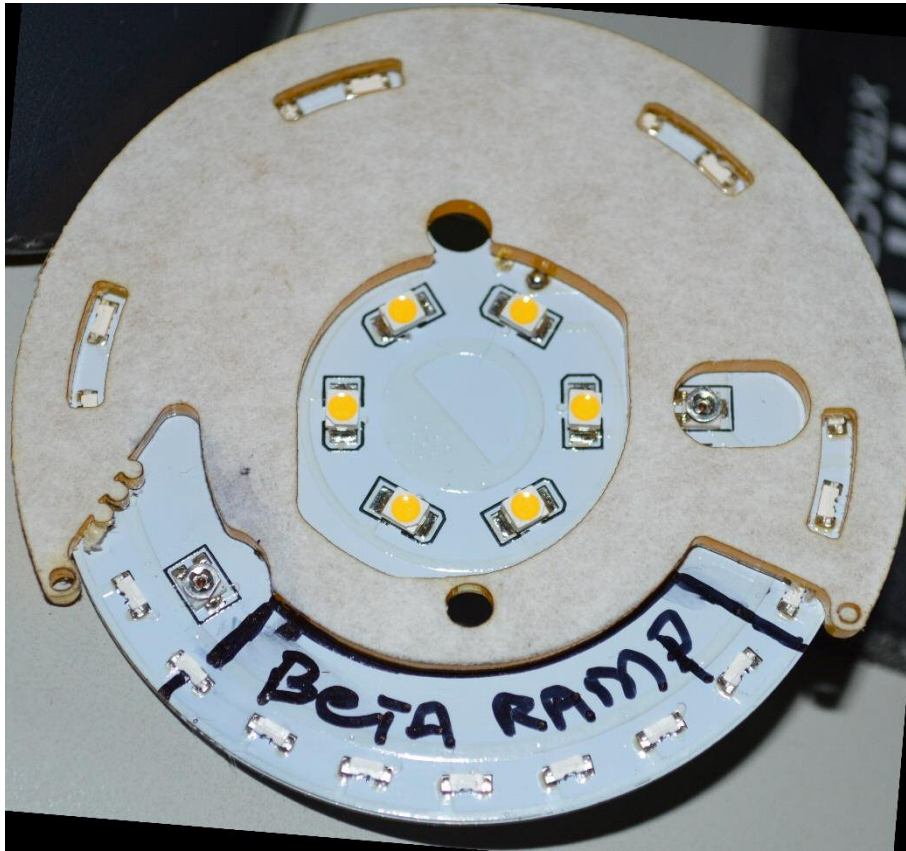


Figure A.1.20 Beta Ramp Cap mark

3. Before cutting the cap; you need to consult the bottom side of the EVO for critical traces to ensure you do not mark the cut line in such a way that the trace is cut. The critical trace feeds K1 on the top side (on the left). I've marked it with a black sharpie arrow in the picture below. This trace connects C1 to K1 and needs to be preserved for functionality. Make sure you verify that the left cut line is far away from this trace. On my board; I cut on the "center line" of that surface mount resistor. You'll also want to make sure the other cut line is basically going to cut a bottom LED in half by going between to two of the surface mounted resistors. Confirm your black sharpie marks protect the C1 /K1 trace. If you need to "erase" the sharpie; use some isopropyl rubbing alcohol and a paper towel to wipe away the sharpie.

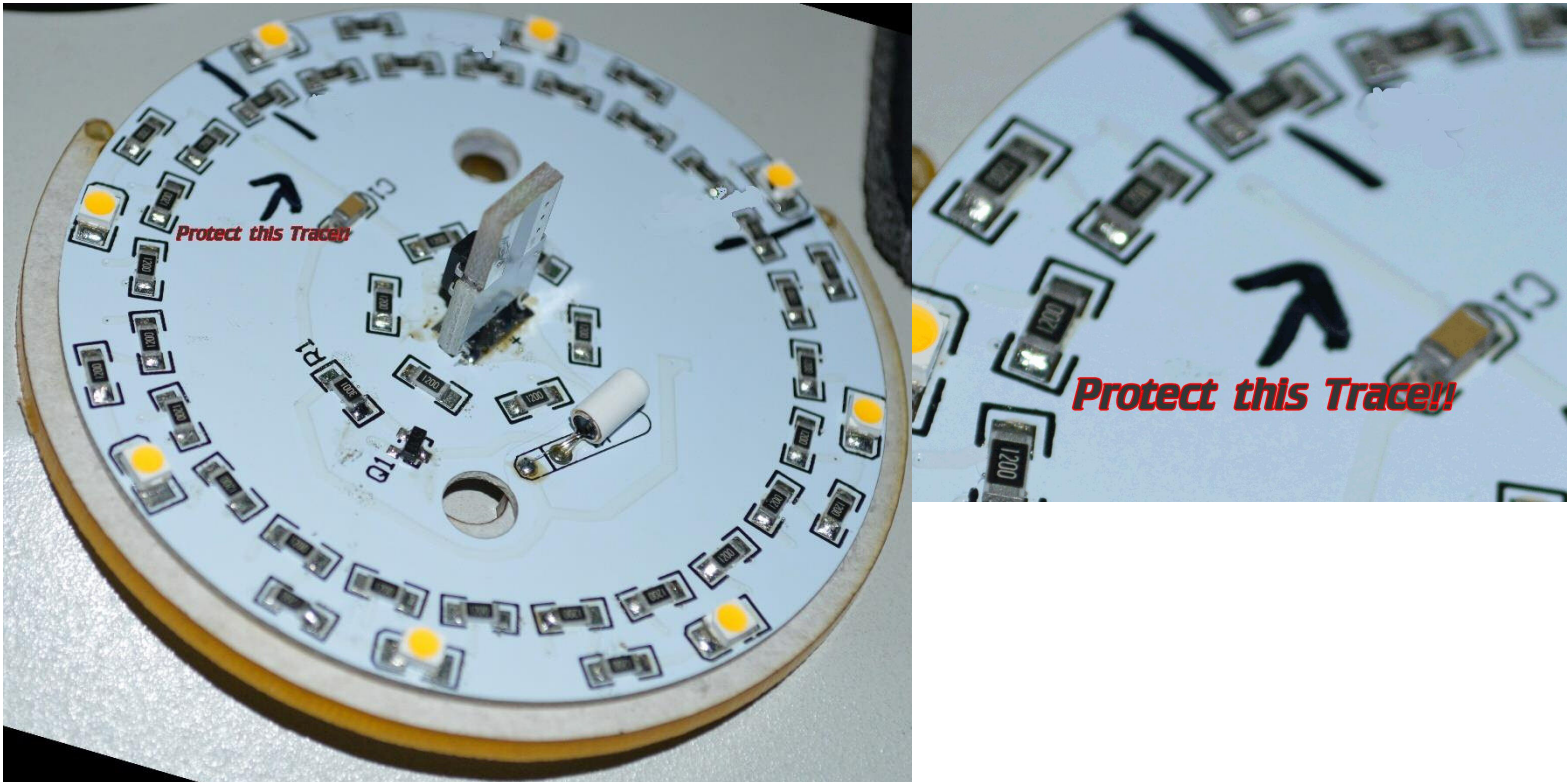


Figure A.1.21 Beta Evo cut marks (secondary side)

4. (optional) If you are going to be replacing the Natural White LEDs with the purple (violet) Kingbright LEDs (which we sell as an optional upgrade); We recommend you remove all the bottom LEDs at this step. To remove the LEDs; we use a SMT Hot tweezer similar to what we linked on page 1. Another option is to cut the LEDs off with some flush cut wire cutters. The key here is you do not want to damage the SMT pads for the LEDs. If you don't have hot tweezers;

cut carefully the LEDs off the board by cutting in the middle of the LED; then use a hot soldering iron to remove the LEDs legs off the board.



Figure A.1.22 Cut or remove the bottom LEDs (optional)

5. Remove any components on the cut lines you've identified to protect the pads and traces from damage if the components are ripped from the board during the cutting operation. In our case; you should remove two surface mounted resistors and at least one bottom mounted LED. There is also one top mounted LED which will be cut; so be sure it is removed as well.

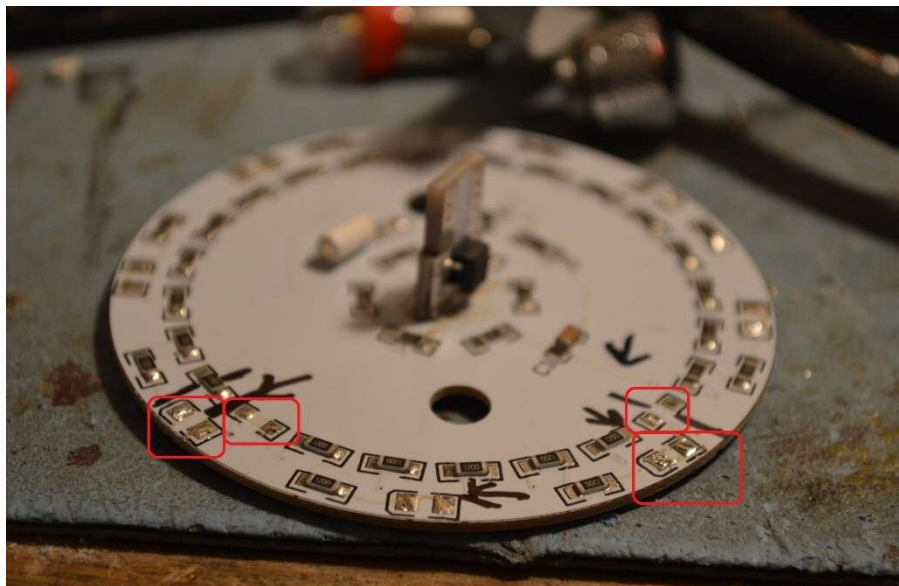


Figure A.1.23 Remove any components on cut lines

- Using a rotary tool (Dremel) outfitted with a reinforced cutoff wheel; Begin cutting on the C1/K1 trace side first; making sure you do not cut that trace.



Figure A.1.24 Use Cutoff Wheel protecting C1 trace identified

Cut the opposite side along the cut line.



Figure A.1.25 Cut opposite side

7. With the sides cut; use the same cutoff tool to cut a trench along the curved line. You don't have to cut completely thru the PCB; just put a deep enough line so the PCB will break on that curve.



Figure A.1.26 Dremel a score into the curved line

8. Grab the PCB with a pair of pliers and break the pcb along the scored line.



Figure A.1.27 Break scored line

9. Use the cutoff disc to clean the pcb edge so it looks more presentable and square.

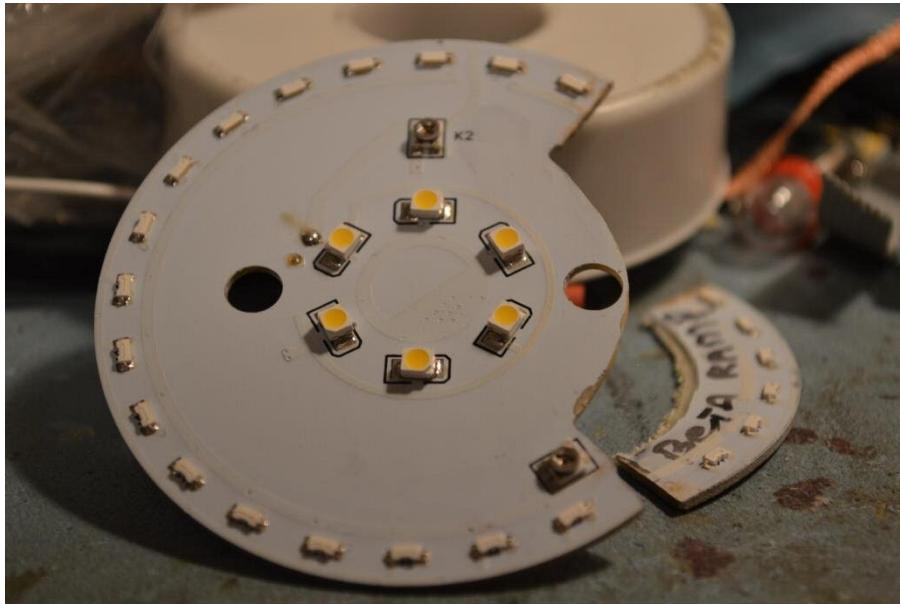


Figure A.1.28 Clean pcb edge with dremel

10. If you test the PCB; you'll note that two of the LEDs will not light because we cut the main trace when we cut out that section. This is easily corrected by bridging over a trace. Locate the main trace and use an exacto knife to scrape off the solder mask on the trace to create a bridge.

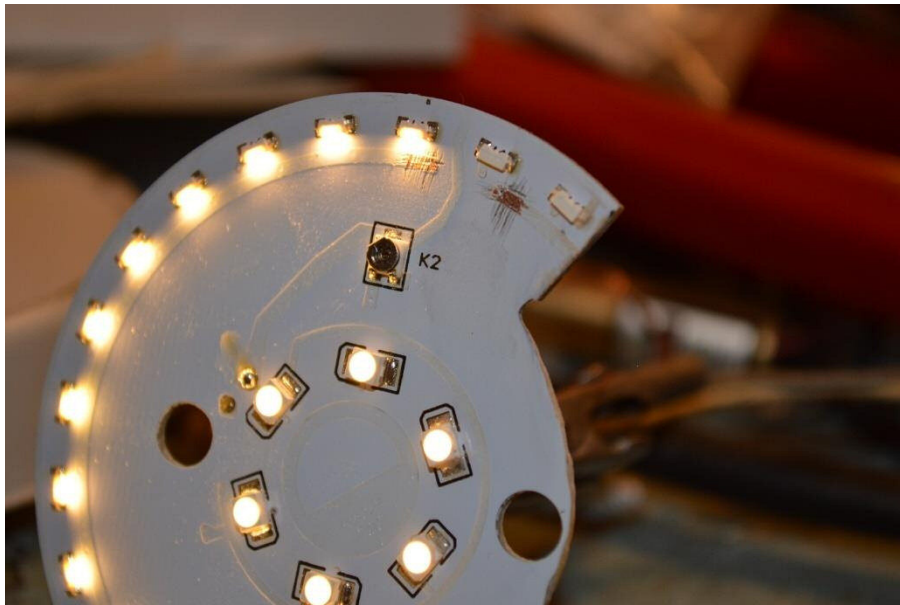


Figure A.1.29 remove solder mask covering main power trace

11. Tin the exposed copper with some solder so that a small amount of wire can be used to connect the traces back together.

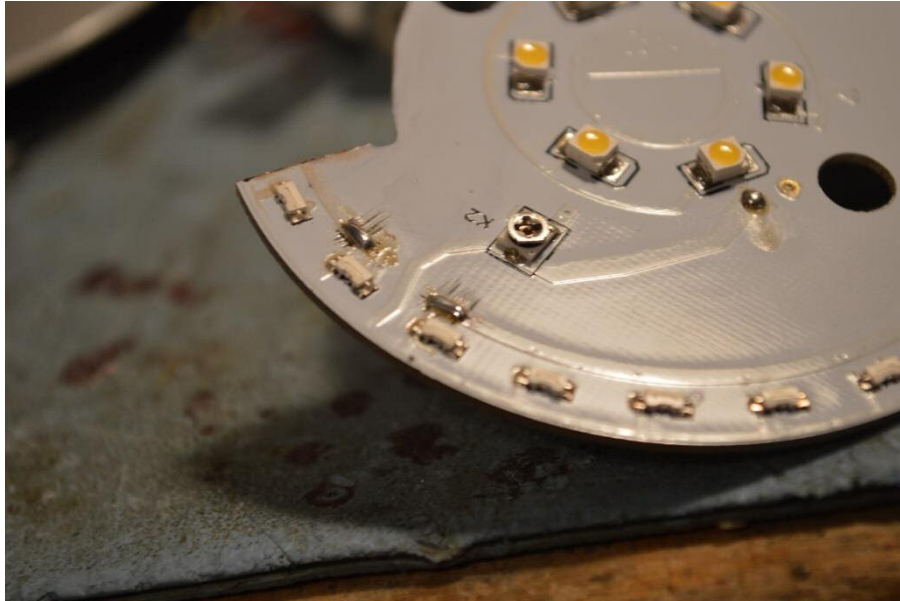


Figure A.1.31 Tin the exposed copper

Then solder a small bridge wire between the two “new” pads. Make sure to keep the insulation of the wire intact so that it won’t run any risk of shorting to the K2 trace under the bridge wire.

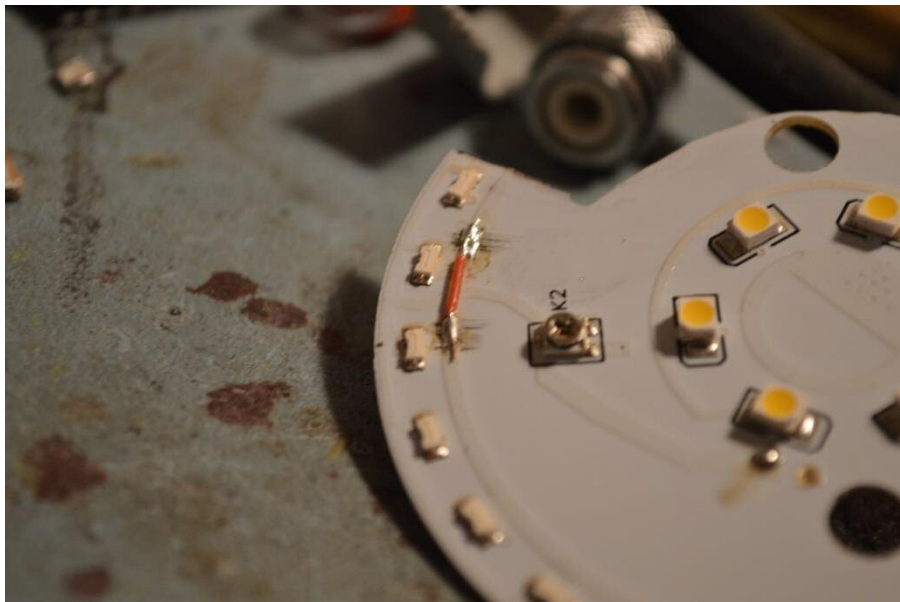


Figure A.1.30 Bridge the trace together

At this point; you can test the pcb to ensure the two LEDs now light:

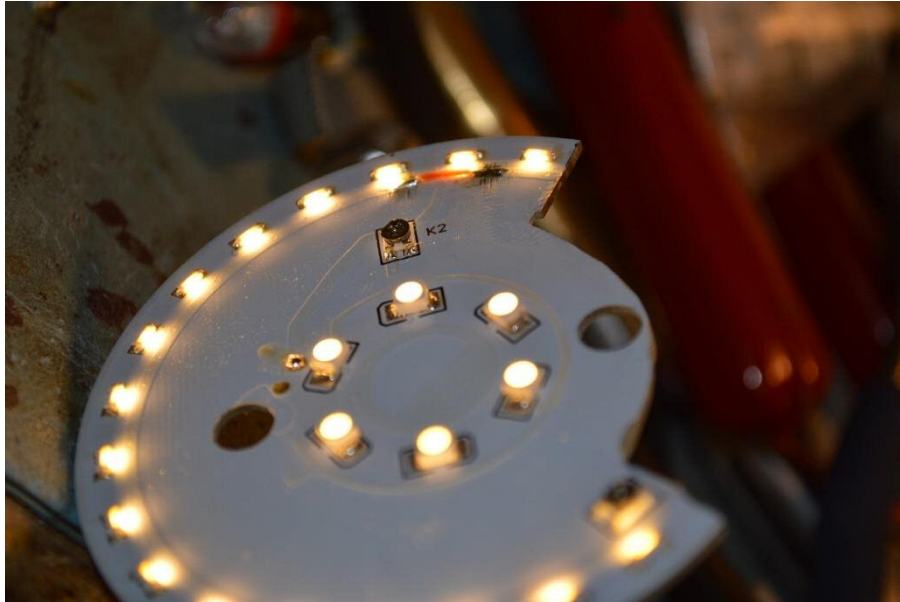


Figure A.1.32 Verify Bridge works with the two LEDs now lit

12. If you did not remove the natural white LEDs in step 4 above; stop here and move onto the next EVO cap in Section A.2.

If you removed the natural white LEDs from the bottom in Step 4; it's now time to install the purple LEDs. Before doing this; ensure you have removed any LED leads from the SMT pads; and clean one of the terminals with some solder wick. The Author removes the solder from the



Figure A.1.33 Clean one if the pads of LED

Anode side so that the new LED can be positioned flush with the PCB. Then ensure you have a

nice amount of solder on the cathode pad of each LED. This will make installing the LEDs easier so the LED is flat against the PCB and ease in positioning the LED while only heating one pad.



Figure A.1.35 Add solder to Cathode pad for LED installation

13. The Polarity of the LEDs matter. The Kingbright purple LEDs optionally provided in the kit have a cathode designator as a small triangle on one side. The side with the triangle is the cathode and the other is the anode. On the EVO PCB; the beveled side of the LED is the Cathode.

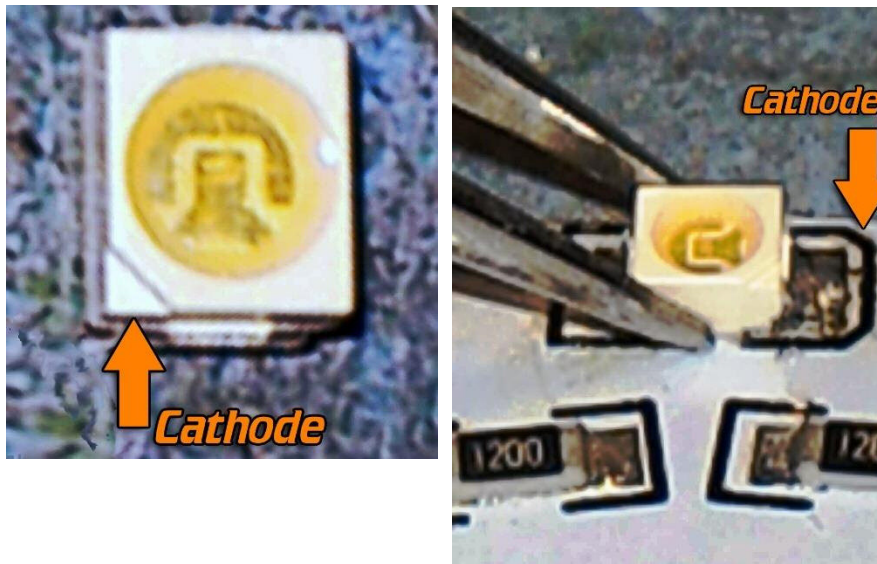


Figure A.1.34 Cathode indicators on the LED and PCB

You'll want to solder the new LED in between the pads using some SMT ESD tweezers. I heat the pad with solder and adjust the LED so it is centered between the pads, square to the pads, and flush with the PCB.

14. At this point I'd solder the other pad for a single LED; plug it into the benchtop power supply and verify the LED lights. If it doesn't; check the polarity of the LED to ensure it matches our pictures. It's possible a future revision of EVO may change the PCB designator; so, if nothing works – try reversing the LED. Only proceed with the other LEDs once you have gotten it to work properly. Once you have the LED orientation correct; proceed to install the remaining LEDs and go back and solder the Anode side of the LEDs (IE both pads).

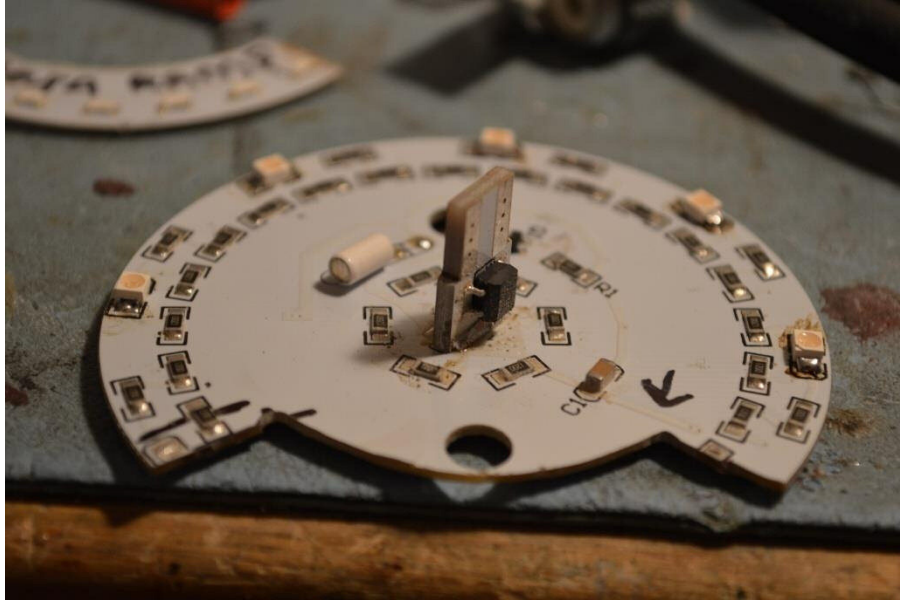


Figure A.1.36 Cathode indicators on the LED and PCB

15. Connect the LED to a powersupply and verify the purple LEDs light as you'd expect. If one or two do not light; verify you don't have cold solder joints and re-check the polarity.

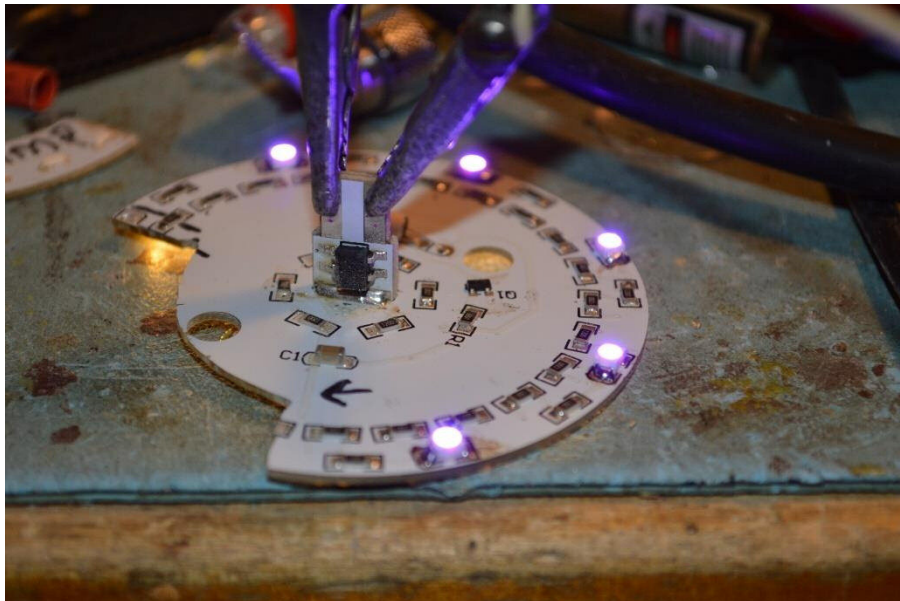


Figure A.1.37 Verify your work

16. The final step is to go back and insulate the bridged trace with some Acrylic Conformal Coating, liquid electrical tape, or just some plain electrical tape. Cover the solder points so they cannot short to anything on your machine.



Figure A.1.38 Insulate bridged trace connections

A.2 Left Jet Bumper EVO modification

Modifying the Left Bumper EVO is going to be a piece of cake compared to the beta ramp cut cap above. Really; we are simply going to swap the LEDs on the bottom side of the EVO cap. If you do not want purple LEDs or did not order the optional SMT LEDs; you can safely skip this and the Right Bumper EVO modifications as there will be no modifications. The bumper we are modifying is designated 12 on page **2-45** of the STNG operations manual. On our machine; we are installing the Uniform color undercaps which requires a Red EVO and the red Undercap. The pictures below will show us modifying a red EVO; but the process should be the same for the Purple or Red EVOs you may be using.

1. Before proceeding; ensure the Red EVO is operating properly and all the LEDs are lit before voiding the warranty below.
2. Because this EVO cap will sit over the Advanced Mission plastic (at the Q shot), The author recommends leaving the back three LEDs with their stock Natural White color so it can illuminate this plastic with no purple tint. To do this; line up the red Undercap on top of the EVO and identify the proper LEDs.

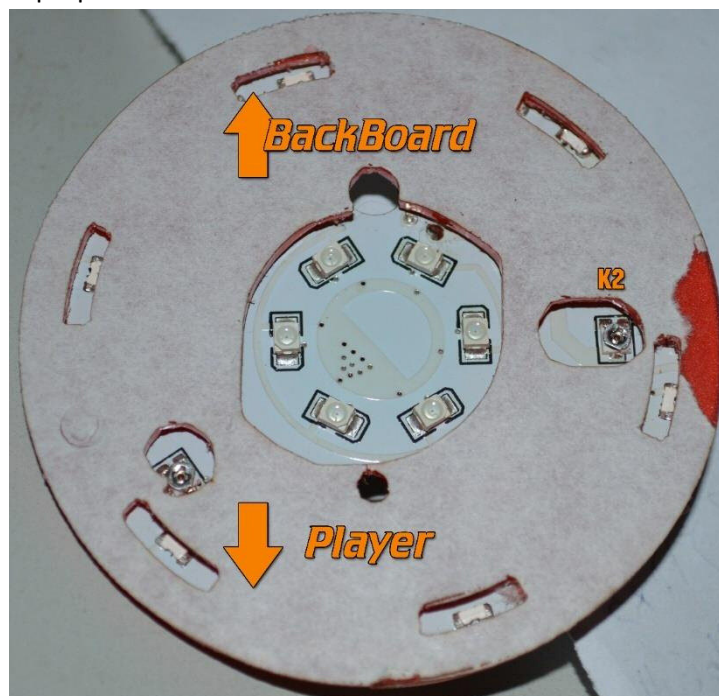


Figure A.2.39 Identify the orientation of the EVO cap

The Advance Mission plastic will be on the player side on the bottom of the EVO. Flip the EVO cap over and mark the natural white LEDs you are going to keep on this evo with a black sharpie.

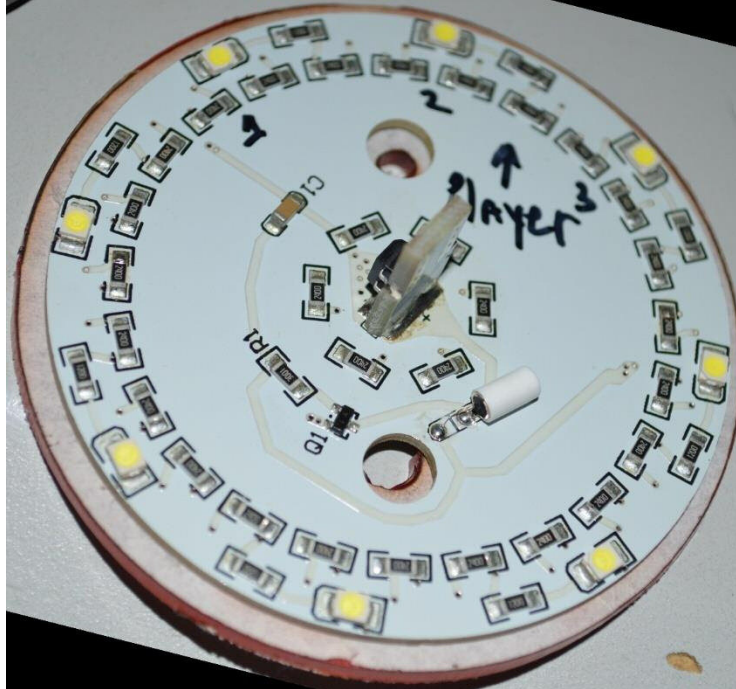


Figure A.2.40 Identify the 3 LEDs to keep

The Author put a direction arrow indicating the direction of the Player and identified these LEDs as 1,2, and 3. He will keep the LEDs natural white and remove the others; converting them to Purple Kingbrights.

3. Using the same technique as step A.1.4 above; The author removed all the LEDs not lighting the Advanced Mission plastic.
4. Once you've removed the LEDs; clean and prepare the SMT pads for the new LEDs identical to steps A.1.12 and A.1.13 above.

5. Test the modified Evo to ensure all the LEDs light properly. If one or two do not light; verify you don't have cold solder joints and re-check the polarity.

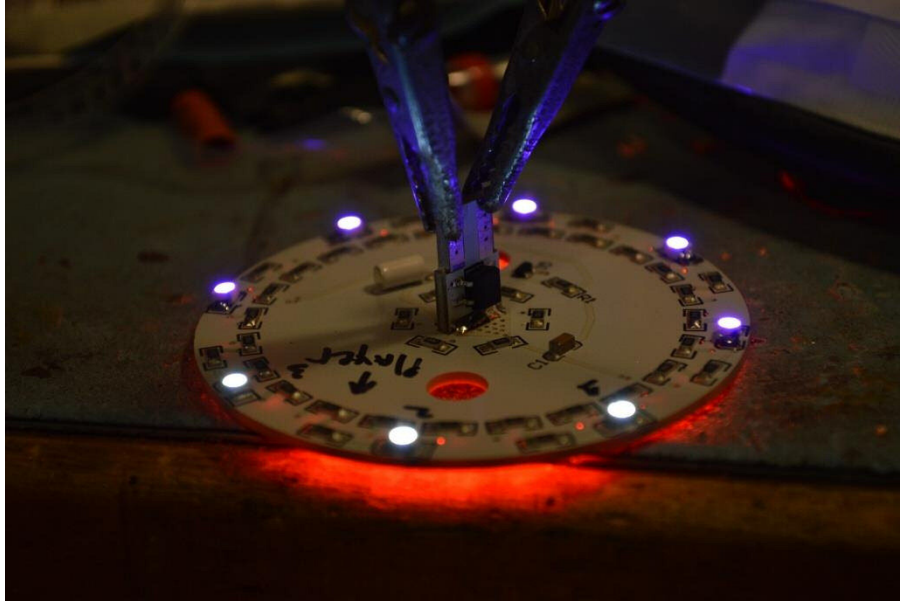


Figure A.2.41 Verify your work on Left Jet Bumper EVO

A.3 Right Jet Bumper EVO modification

The last EVO modification recommendation is for the Right Jet Bumper designated item 13 on page **2-45** of the STNG operations manual. On our machine; we are installing the Uniform color Undercaps which requires a Blue EVO and the Blue Undercap. We didn't take any pictures of this modification; because if you've done the other two EVOs as above... this one is going to be super simple.

1. Before proceeding; ensure the Blue EVO is operating properly and all the LEDs are lit before voiding the warranty below.
2. This EVO requires no special LED lighting due to plastics; therefore, we simply replaced all the Natural White LEDs on the bottom side with the Purple Kingbrights. Using the same technique as step A.1.4 above, removed all the bottom White LEDs.
3. Once you've removed the LEDs; clean and prepare the SMT pads for the new LEDs identical to steps A.1.12 and A.1.13 above.
4. Finally; Test the modified Evo to ensure all the LEDs light properly. If one or two do not light; verify you don't have cold solder joints and re-check the polarity.

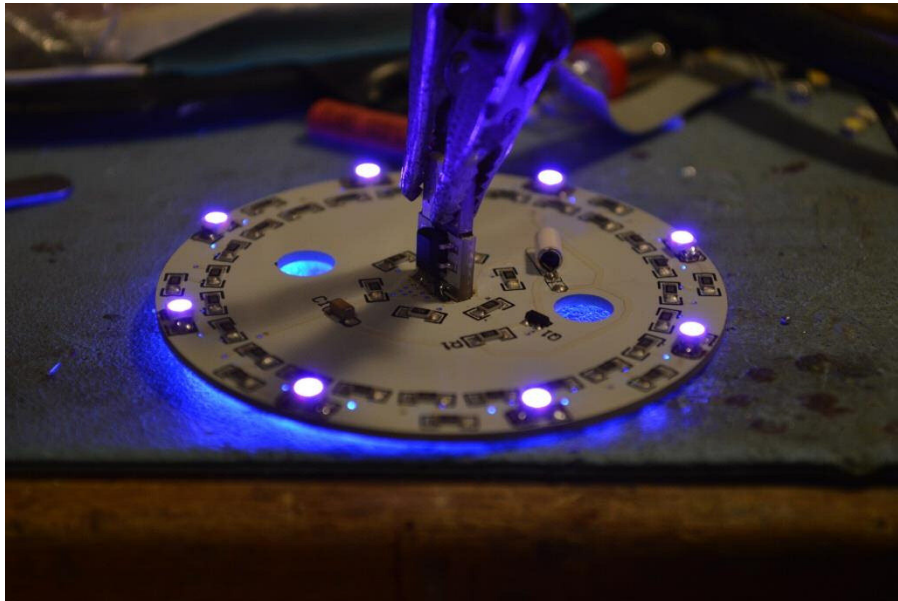


Figure A.3.42 Verify your work on Right Jet Bumper EVO