

CC Connection Port

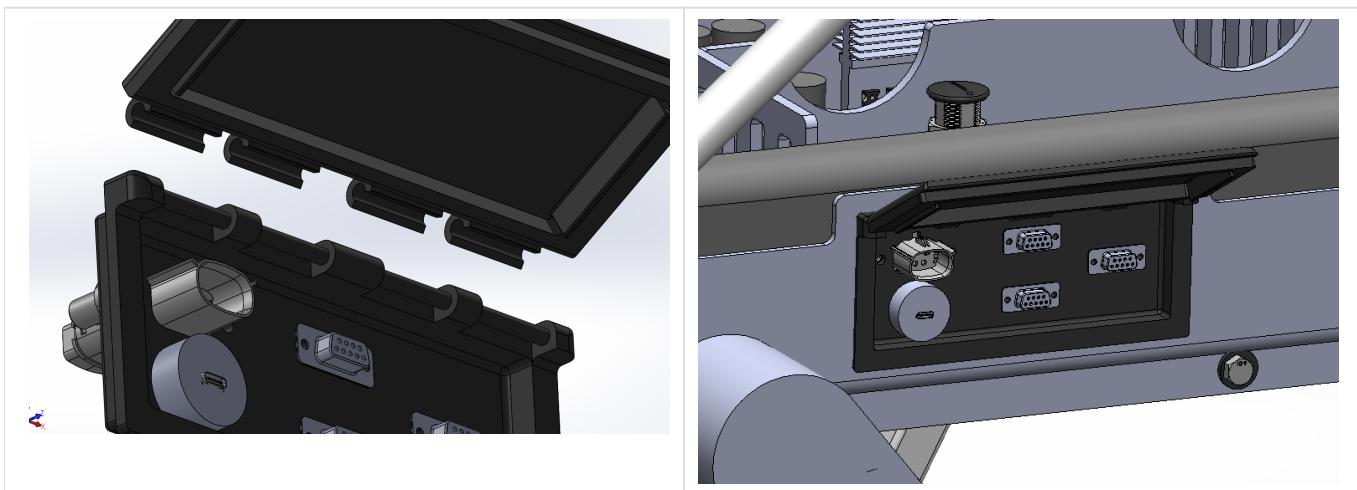
Intro

The side of the catamaran cover will have a port that houses the connectors we need such as USB-C for phone charging and CAN debug outputs. [@ Renzo Villanoy](#) originally designed a port housing and cover to be 3D printed but the design for the hinge had some issues that needed to be improved upon. The goal of this mini project was to find a redesign for the port cover and housing that is able to meet all the requirements and is easy to use.

Requirements:

- Outer dimensions do not change
- Must be 3D printable, the simpler the better, the less parts the better
- Easily accessible
- Robust when closed, shouldn't swing open from the vibrations of the car
- Cover should have range of motion of at least 90 degrees from closed position
- Cover should **completely** enclose connectors

Original Design



This design had some issues with assembling the hinge, as well as the hinge interfering/getting in the way of the lid's movement. The hinge was also visible when the lid was closed, which was unideal in terms of interior aesthetics.

Redesign Ideas

There were mainly 2 options that were considered for the redesign. Either continue with the hinge design, improving the hinge, or recreating a sliding cover that could slide to open/close the housing. Some quick thoughts about each option were brainstormed.

Cover with Hinge

- Hinge should ideally be inside the cover, concealed when closed
- Needs lock mechanism, ensure doesn't open/close/bounce due to vibrations
- Needs a way to assemble the cover and housing, or to print both pieces together in place

Sliding door

- Can stay open while ports are in use, without needing to be held up manually
- Does not take up "horizontal" space when opened, simply slides to side
- Might be harder to 3d print / assemble

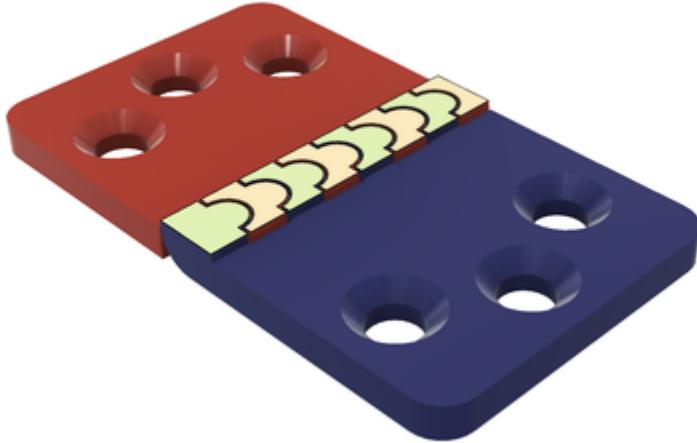
Water Soluble Support Material Research

- As I have never worked with water soluble support material before, I compiled some research about printing with water soluble filaments into this doc:

Hinge Research

- Living hinges
 - Basically having one solid hinge that physically bends

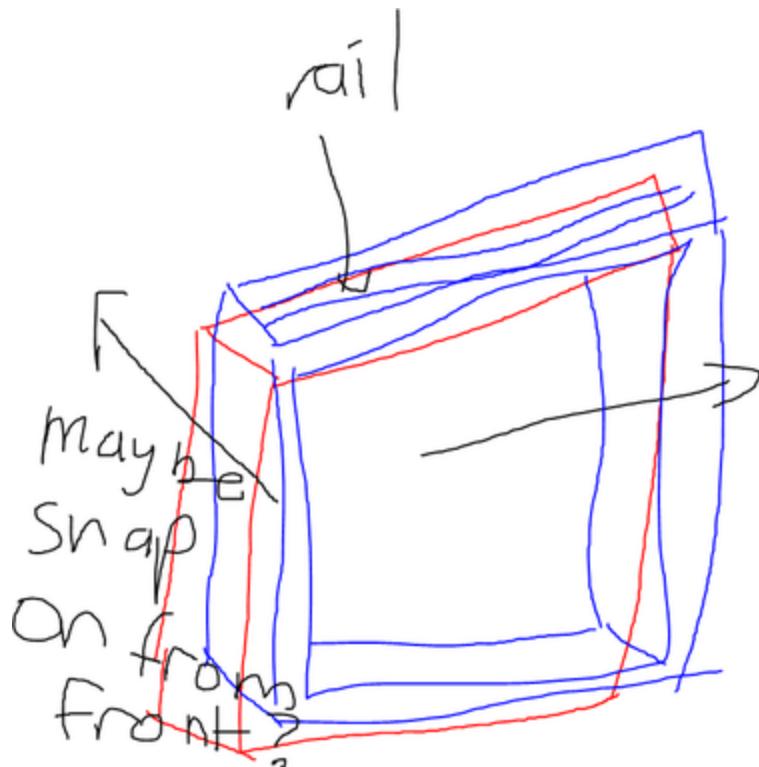
- Cool idea for hinges, not designed for durability though, mainly used for prototyping or for uses where the durability of the hinge is not important
- Parametric Hinge
 - Your typical hinge
 - Need to consider how to remove support material inside hinges if printing all together
 - Inspiration for possible hinge designs
 - <https://www.thingiverse.com/thing:2187167>
 - <https://www.thingiverse.com/thing:1551631>
 - <https://www.thingiverse.com/thing:1396038>
 - <https://www.instructables.com/Parametric-Print-in-Place-Hinge/>
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- One in place print hinge design, looks interesting
- Would probably try this design for the hinge

Sliding door

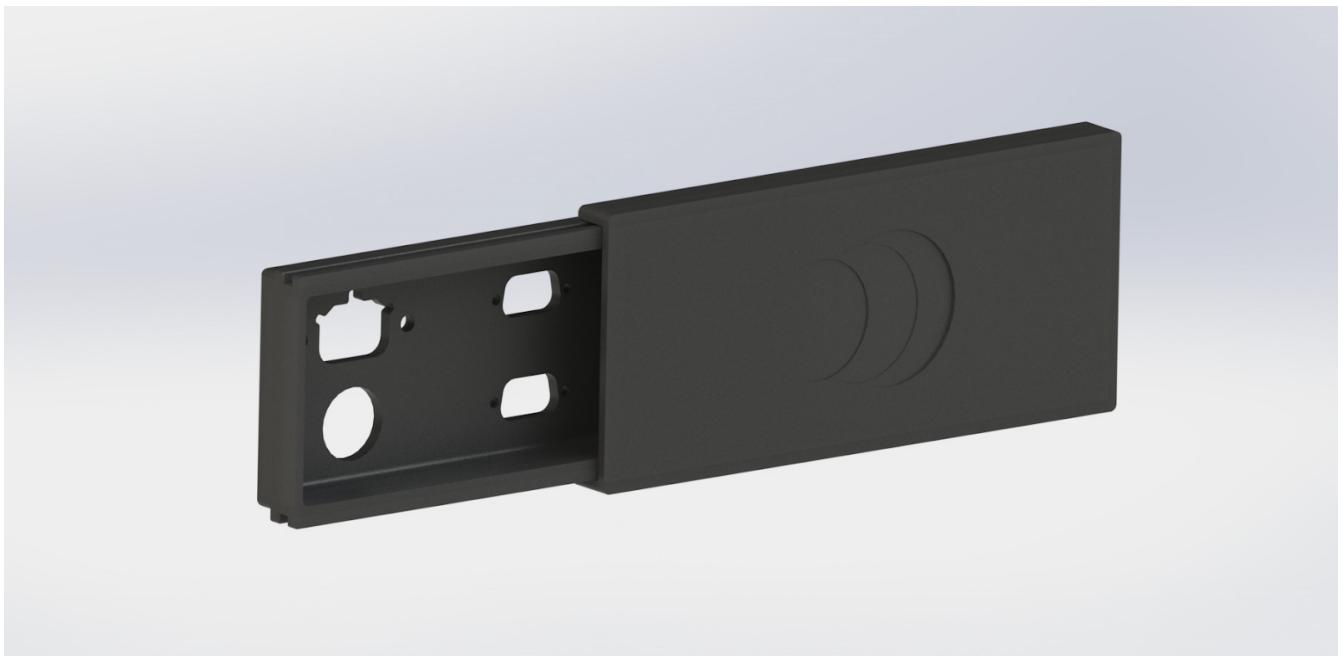
- Not much (or any) designs found for a sliding door, but the concept is pretty simple
 - Have “tracks” on top and bottom of the housing, and “rails” on the inside of the cover that can run along the tracks when the cover is pushed/pulled
- Some thoughts considered when designing the sliding door
 - Need to see how much space there is
 - How to 3d print and assemble?
 - Need to get the “rails” onto the tracks, while having a stopper to limit the cover’s movement so that it doesn’t just slide off the housing entirely
 - Should the cover slide open sideways or upwards?
- Ended up deciding on designing a sliding door, as with all considerations, it seemed reasonable to create, and seemed to be the better option in terms of using it in the car.



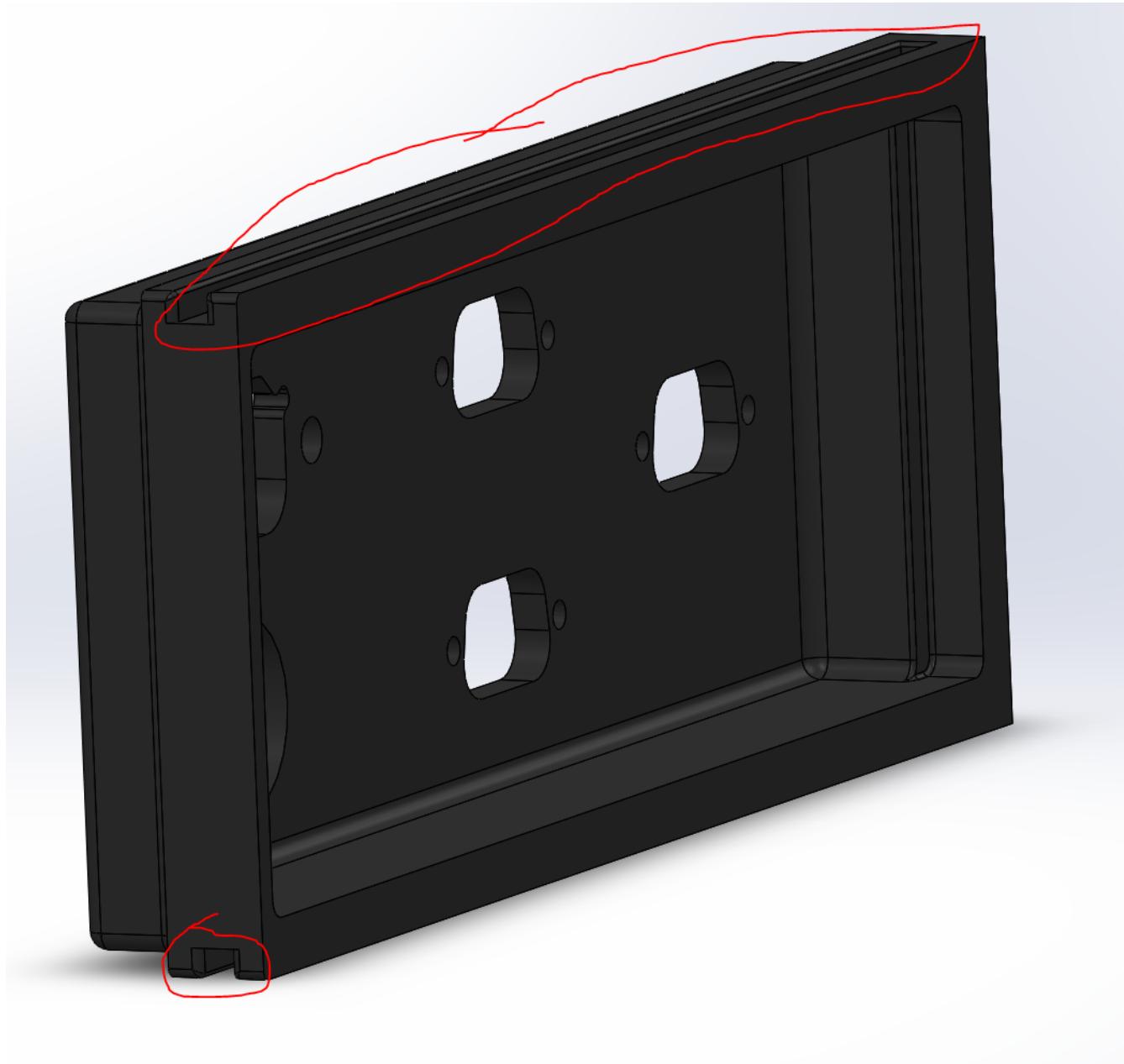
A (super sketch) sketch about what the sliding cover would look like. An idea to snap the rails in place from the front was an idea, however, the 3D print material would probably not be flexible enough.

Upon deciding on the sliding door, I just went into Solidworks to try to work something out. I took the original model that Renzo made, and cut off the hinges, and designed the basic "track rail" system for the sliding cover.

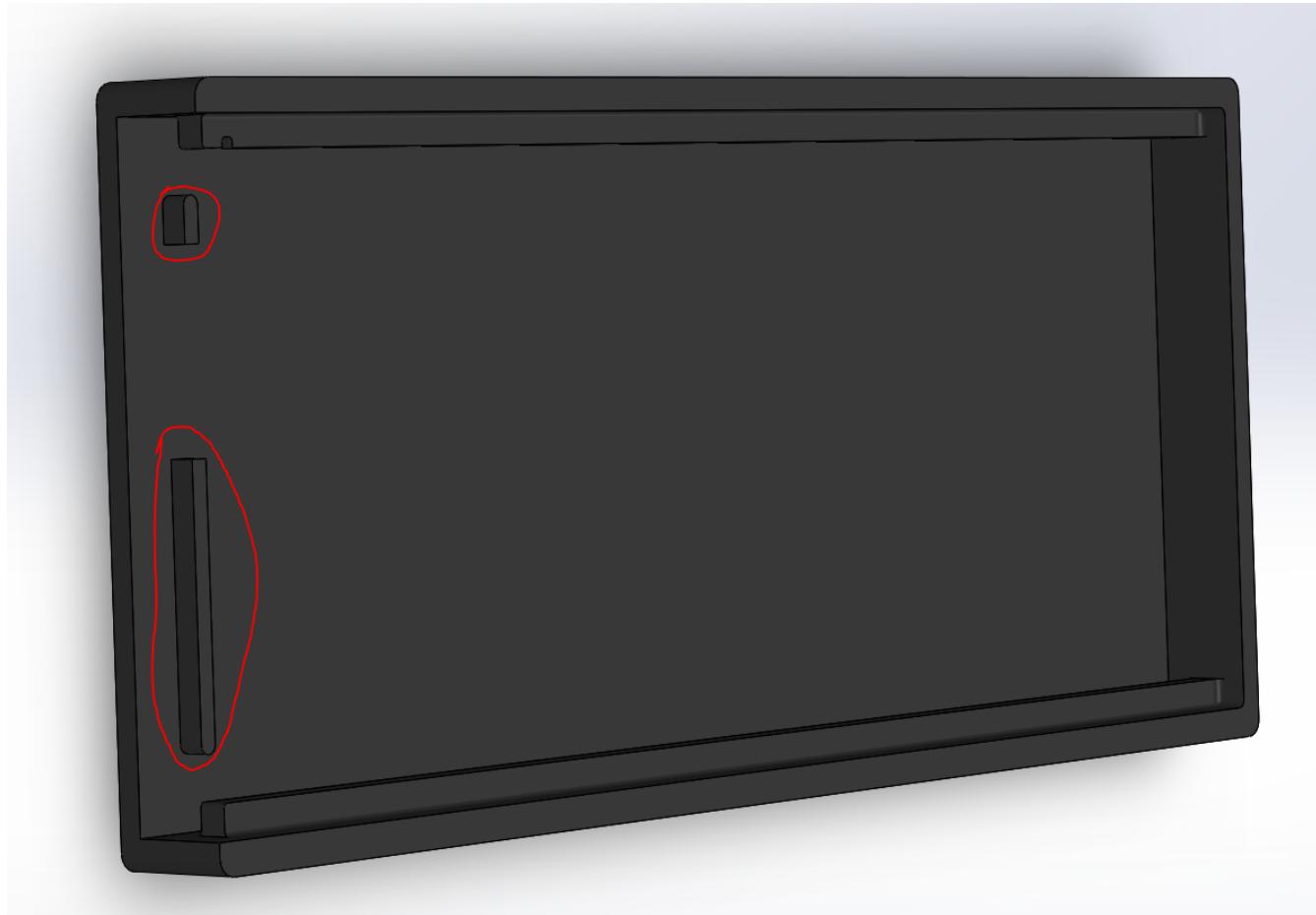
▼ First Redesign



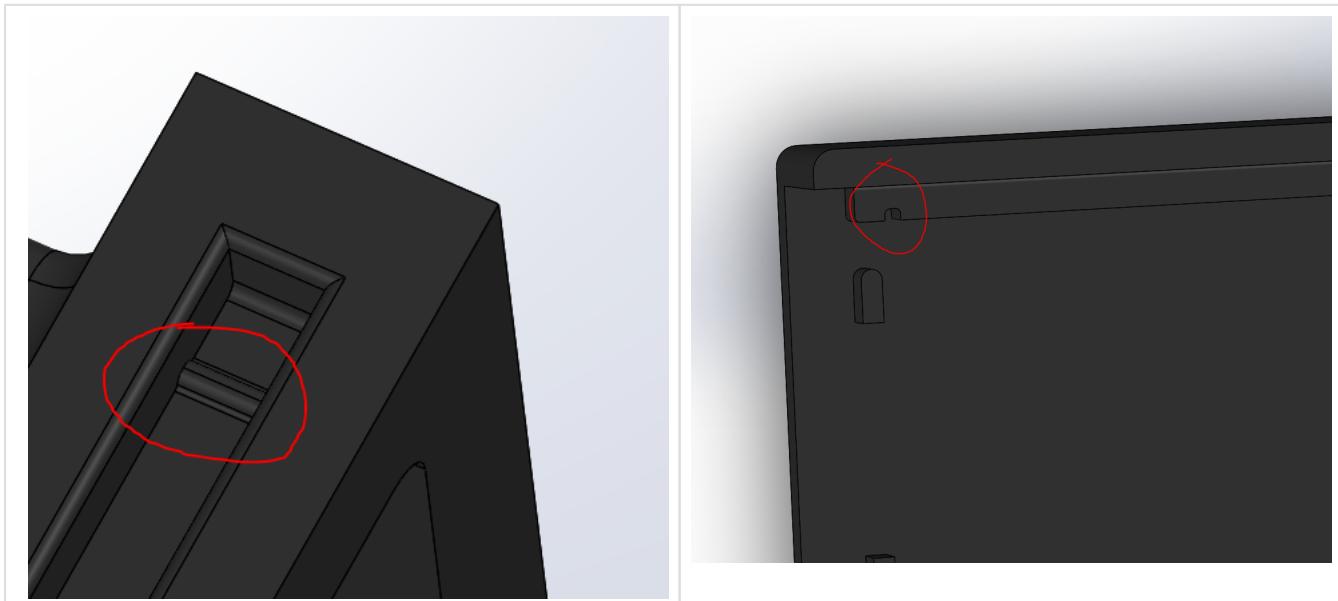
- Took base design that Renzo created, and removed hinges
- Designed sliding door



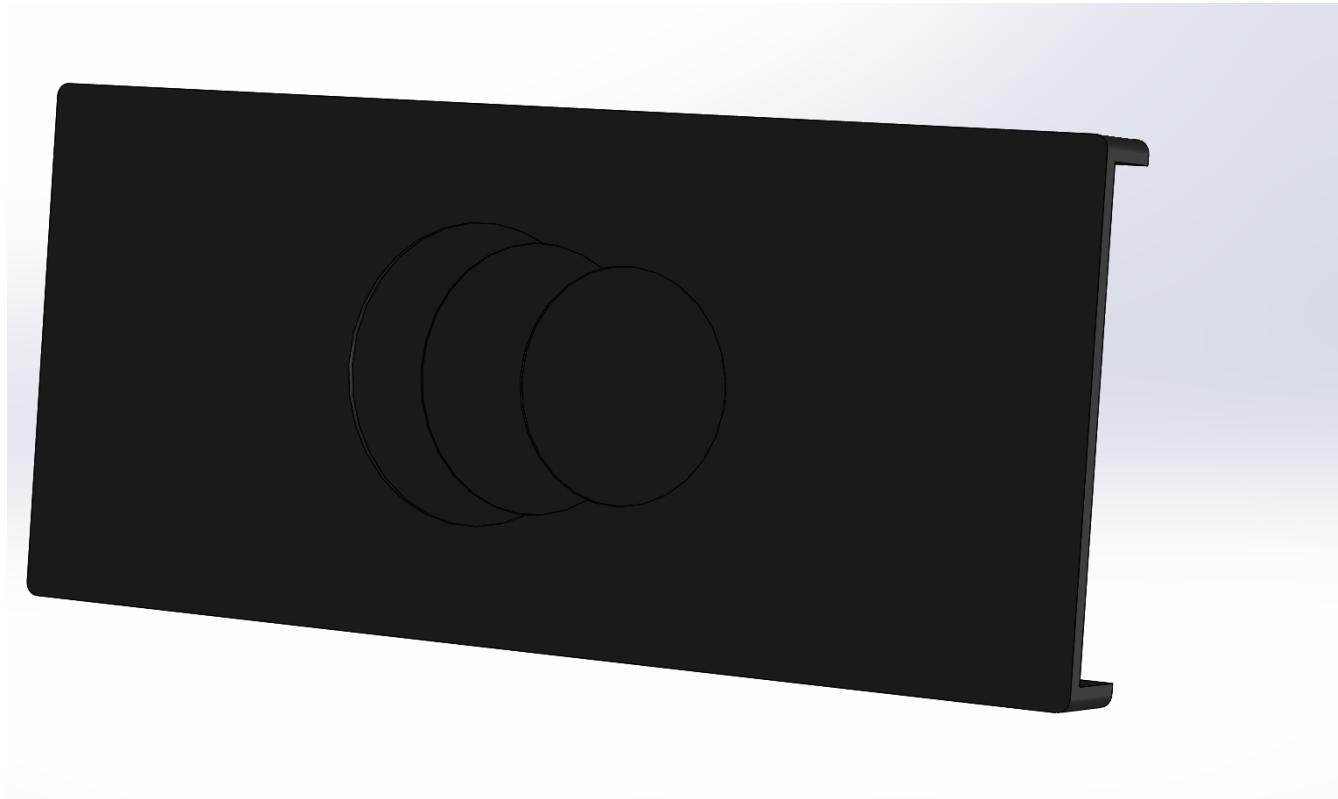
- Added rails for sliding on top and bottom of case
- Trimmed case so that the overall dimensions of the housing remains the same as before



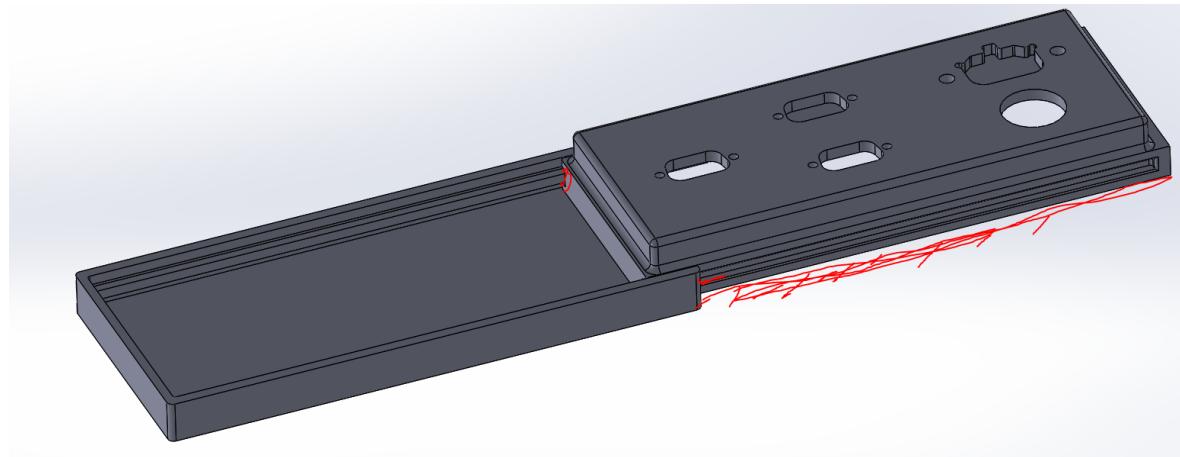
- Added stops
 - Limits movement of case, ensuring doesn't slide off



- "Soft lock" , basically way to make the cover stay in place when closed
 - There is an extra 0.25 mm clearance on the top and bottom sides, and the hump is 0.5 mm tall. When the cover is pushed over the hump, it should go over the hump and sort of lock itself when closed.
 - Only on the top rail, bottom rail is fully smooth



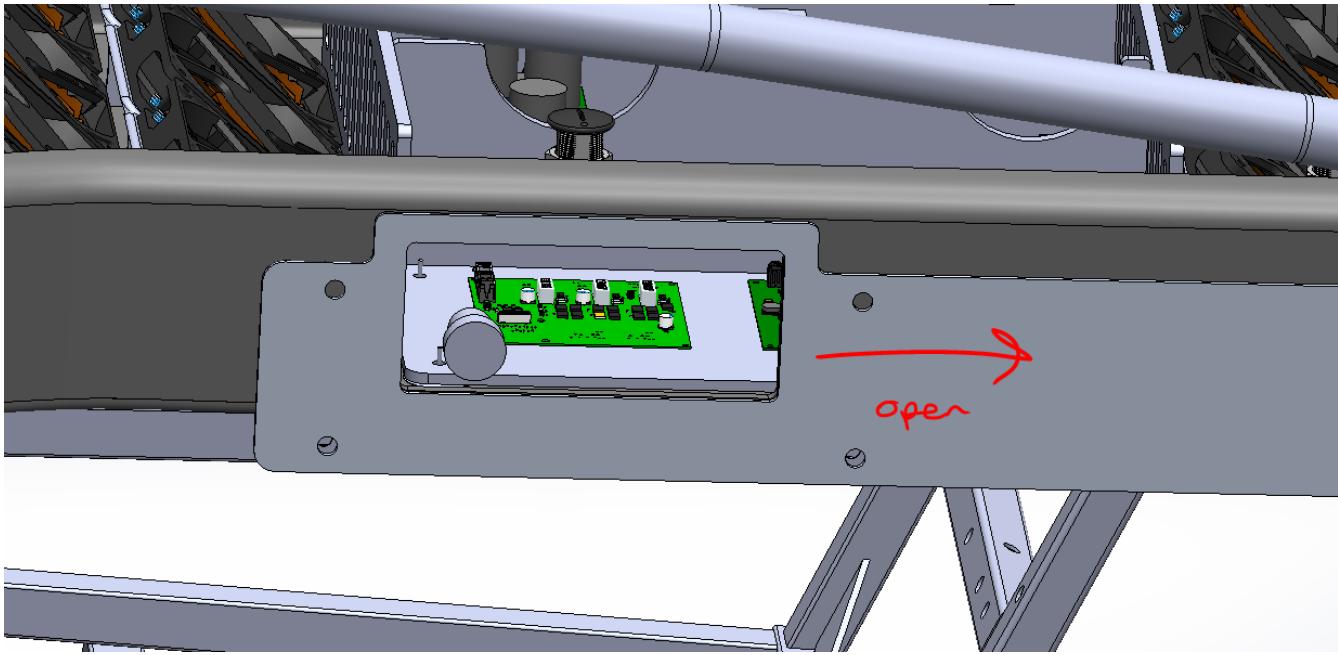
- Random design that I added for fun
 - Can be changed or removed
 - Included grooves to enable opening the cover by pulling on the design
- Main concerns after first design:
 - The design had the cover and housing printed together, as I had not thought of an idea on how to assemble the cover with the housing. The stops prevented the cover from being simple slid onto the rails.
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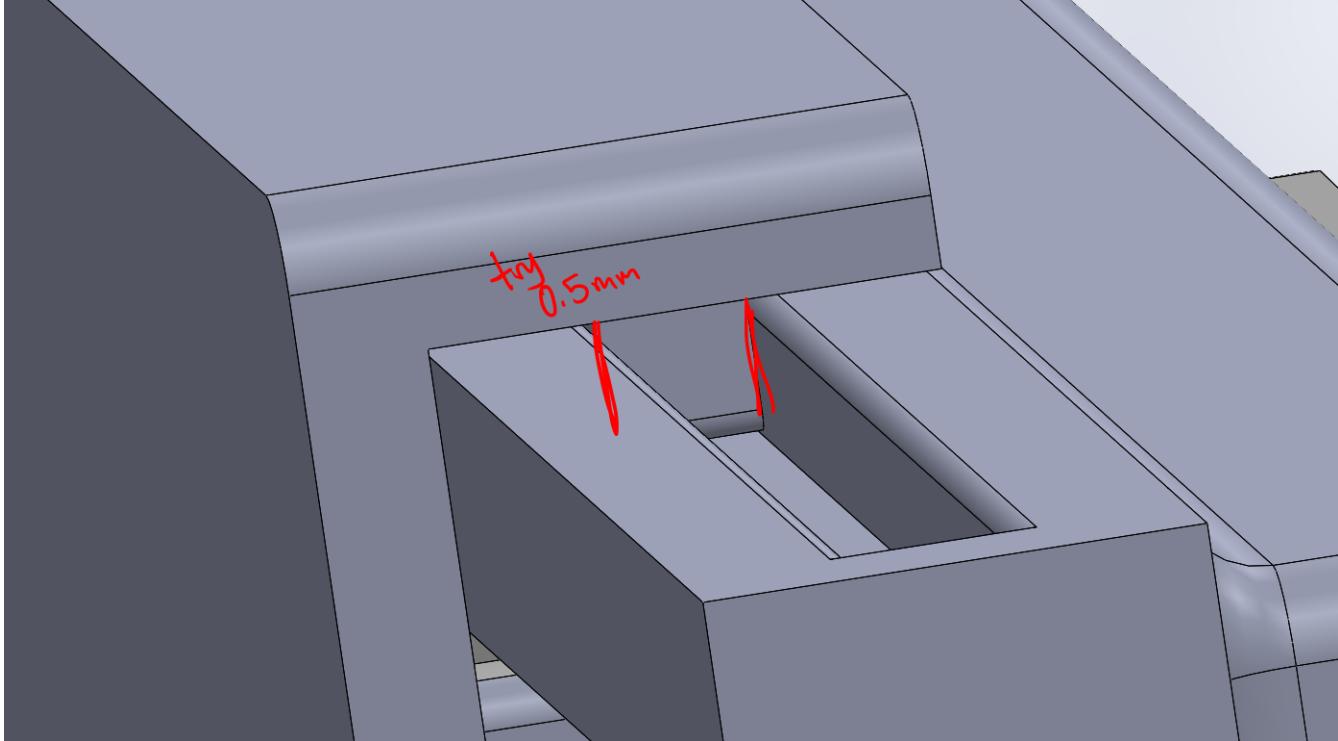
- The idea was to print the cover and housing offset from each other, to minimize the amount of support material printed between rails and tracks, which could be dissolved later.

First Design Feedback

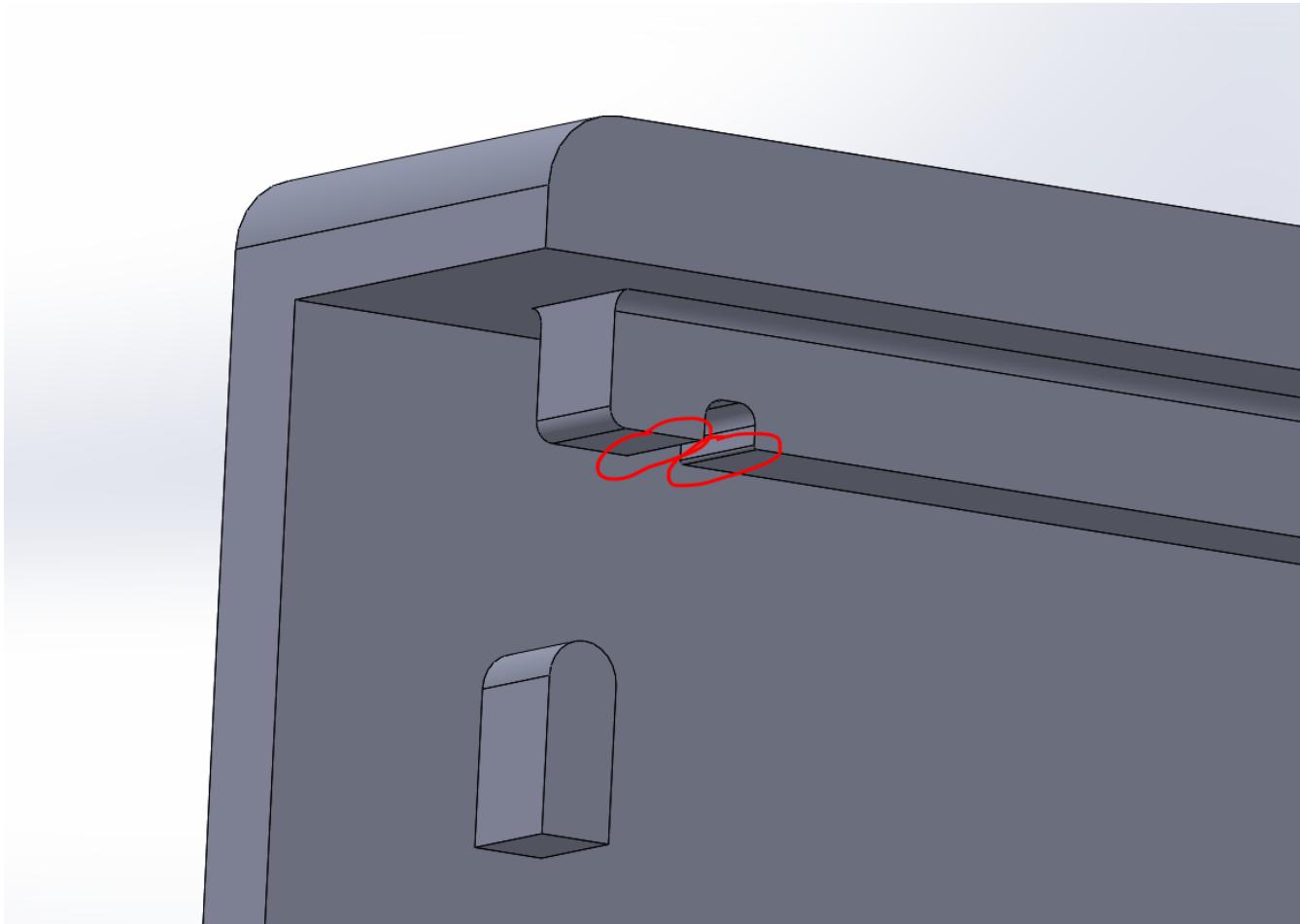
- The cover should slide open to the right. The Catamaran cover has a curve on the left that might interfere.



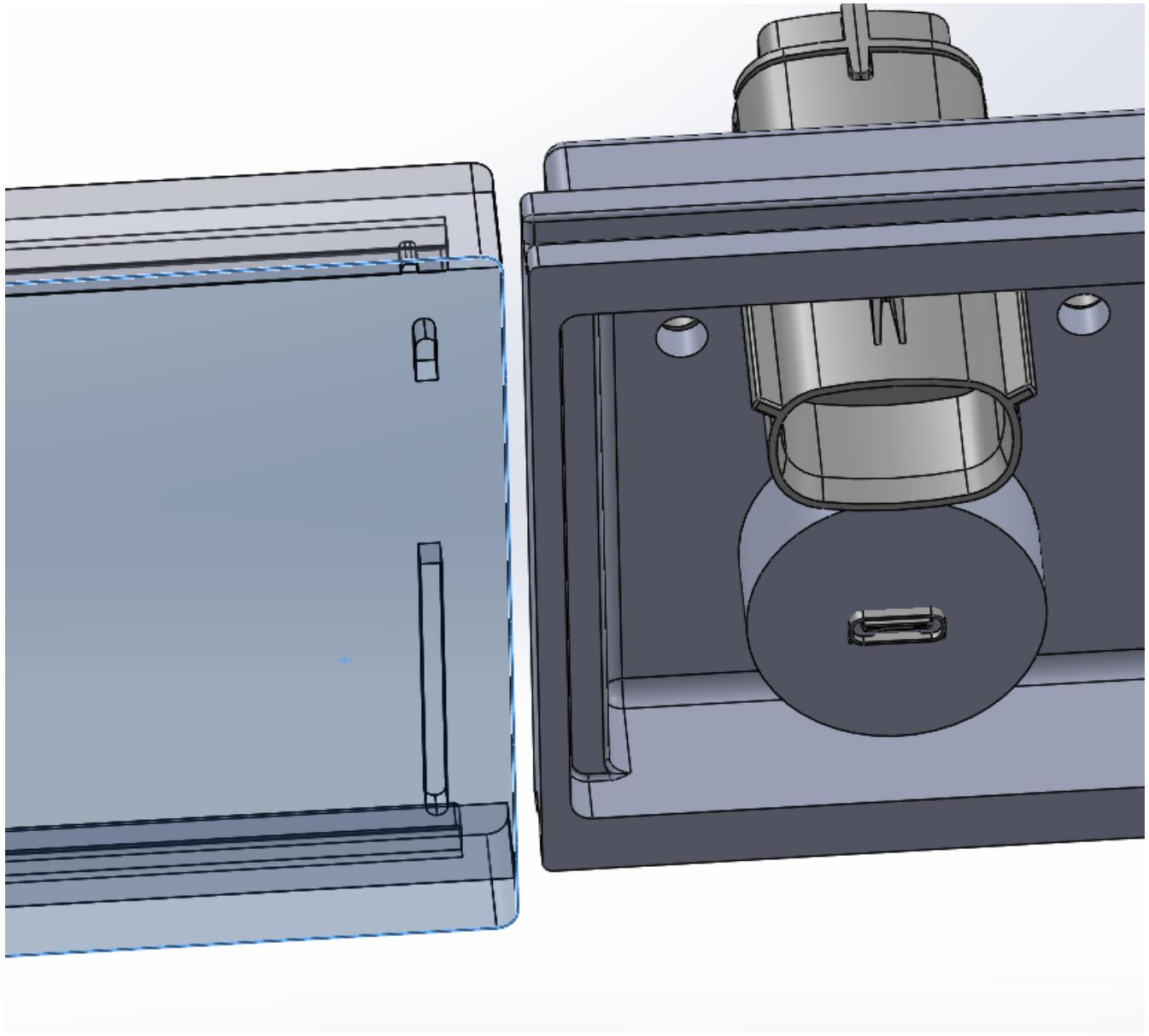
- Some more clearance should be added on either side of the rail, around 0.5mm on both sides.



- This fillet radius should be increased because the 3D printer may not be as precise.

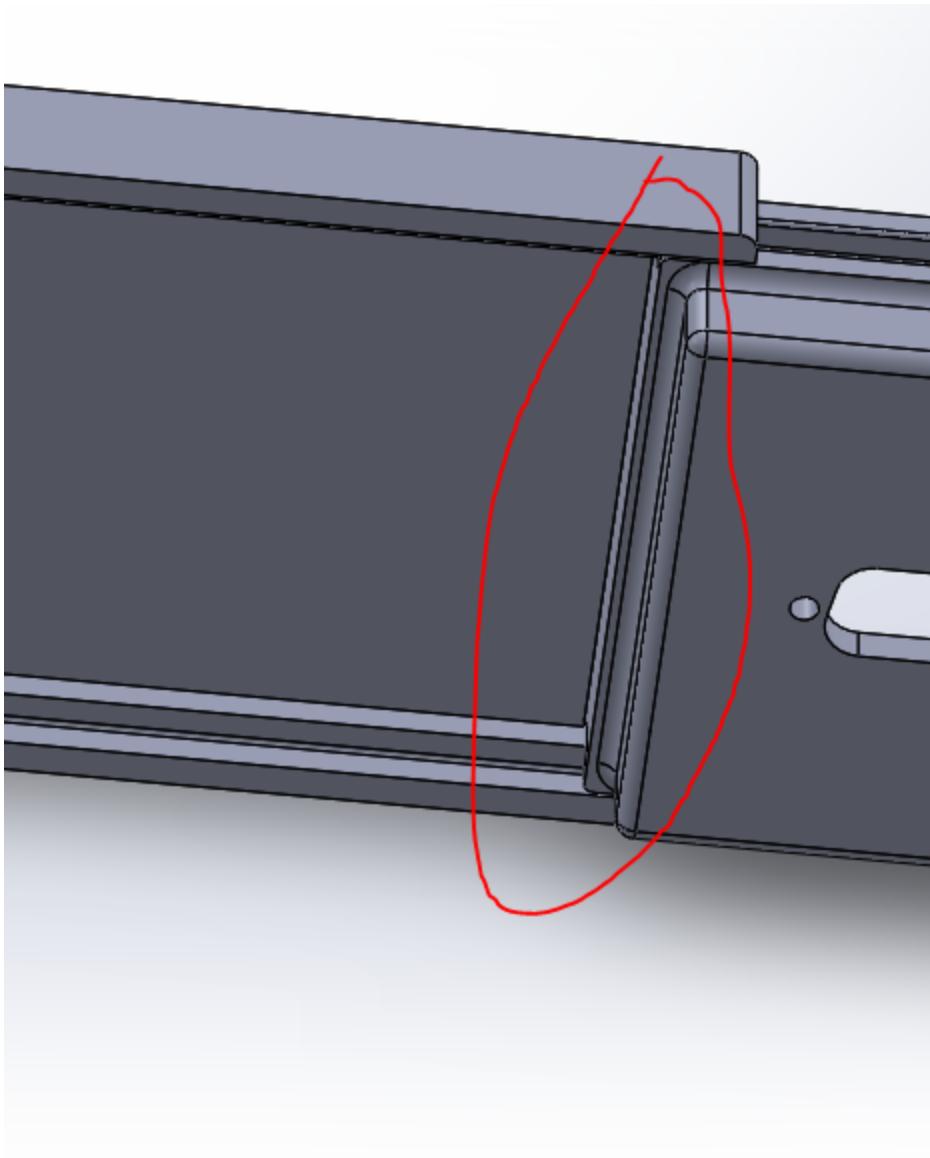


- It might be better to print as 2 separate pieces, cause right now there's no way of getting the cover on the rails. I could design another separate piece that we can just super glue on after to stop the cover from sliding out.

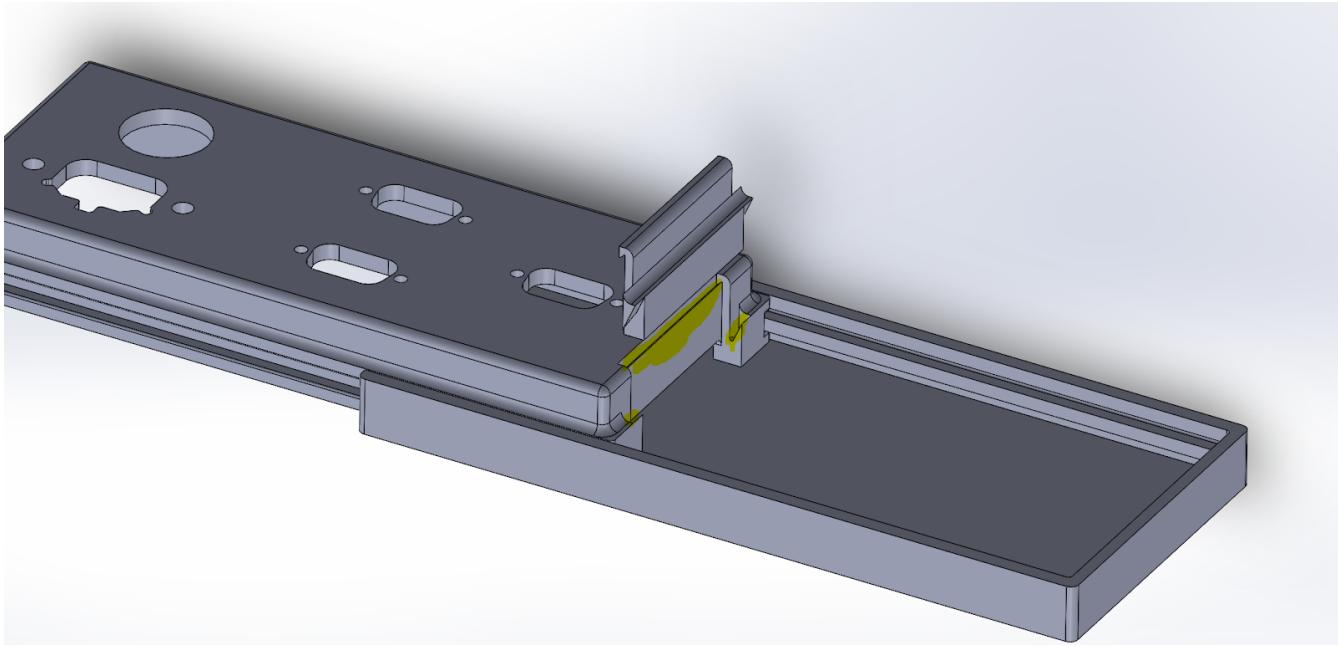


▼ Redesign Iteration 2

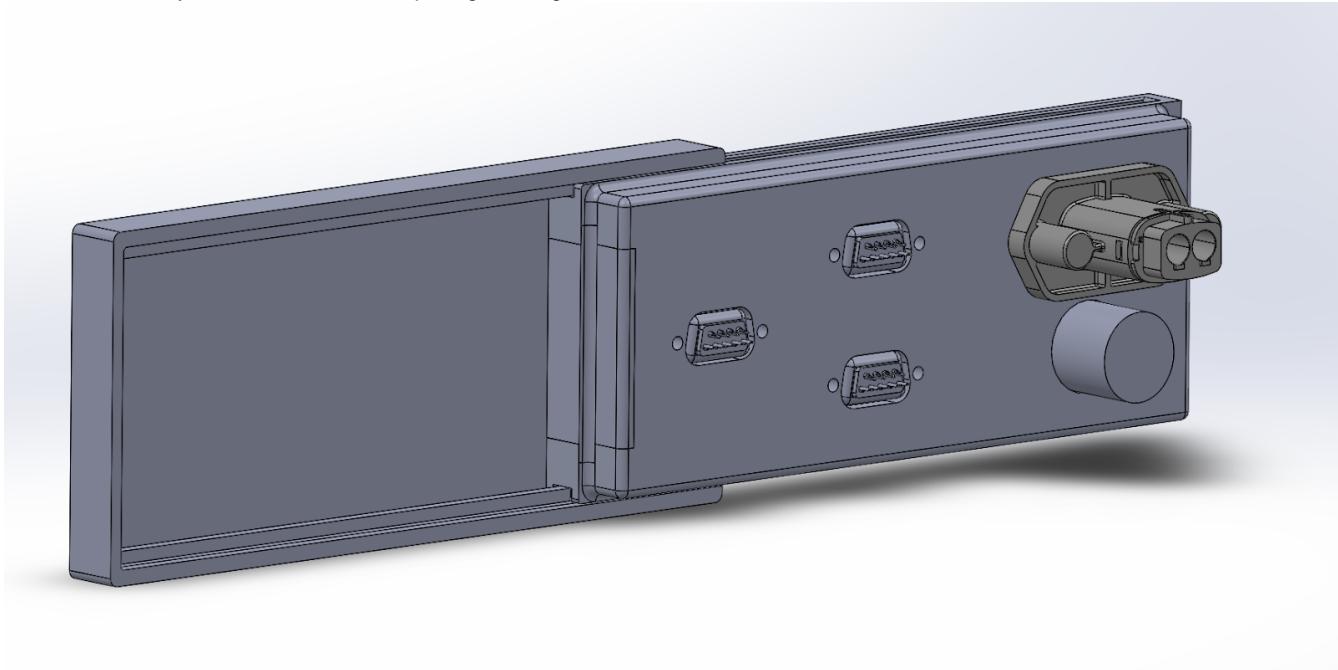
- Idea was to put the glued on piece this back part, so that it would be theoretically concealed and never actually seen



- Cut out a part to insert from back once the cover is on the rails



- After the cover is slid on, this piece can be slid in from top, super glued, and will act as a stopper, preventing the cover from sliding off
- Technically cannot be seen when opening / closing the cover when it is set in the car



- In total, will be 3d printing 3 separate pieces
- Rest of the issues such as clearance and fillet size were updated as well

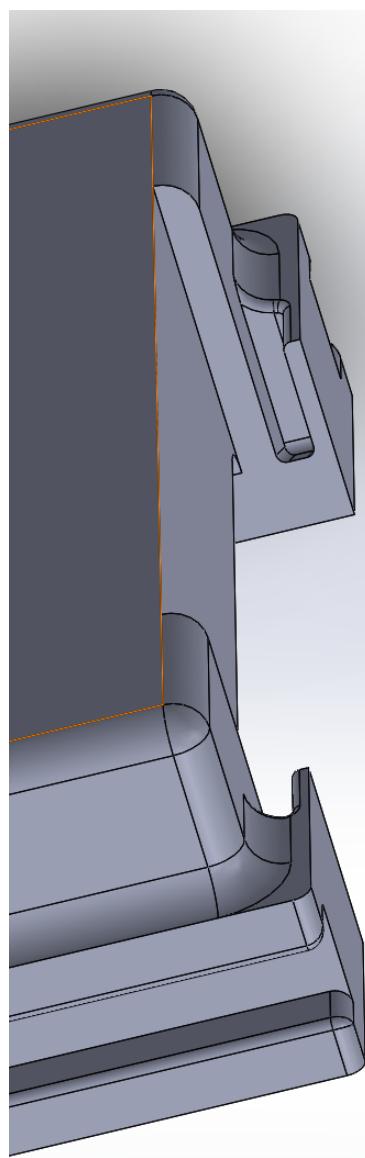
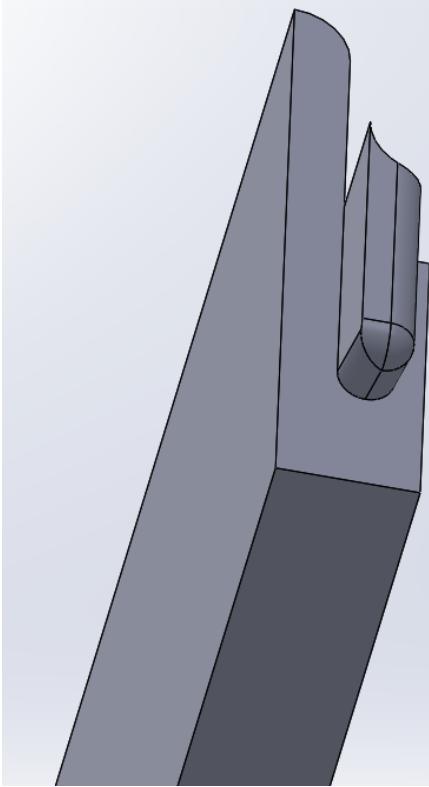
▼ Iteration 2 Feedback

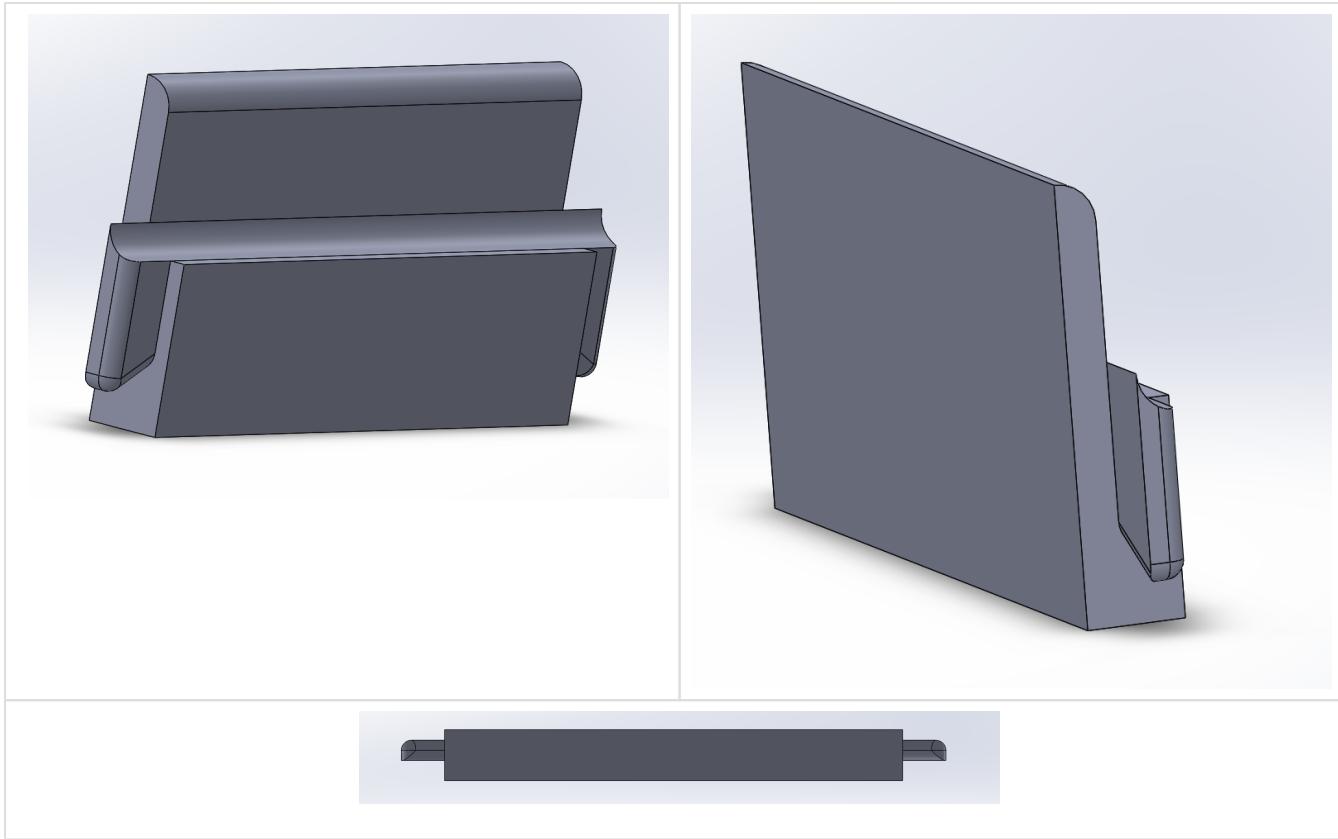


- We can definitely simplify this glue-on piece because these sharp parts won't print very well. Though I see what you were going for with the "locking" features
- Try to think about the manufacturing process and how this will be oriented on the printing bed – this means minimizing overhang and extreme geometry as much as possible
- The locking can still be achieved with right angles (shown in the sketch)
- To the passenger, this side of the housing will always be covered so you're allowed to modify it (bottom left pic)
- You can remove the design on the port cover and leave it blank for now – we'll figure out what to put there once we do a test print

▼ Redesign Iteration 3

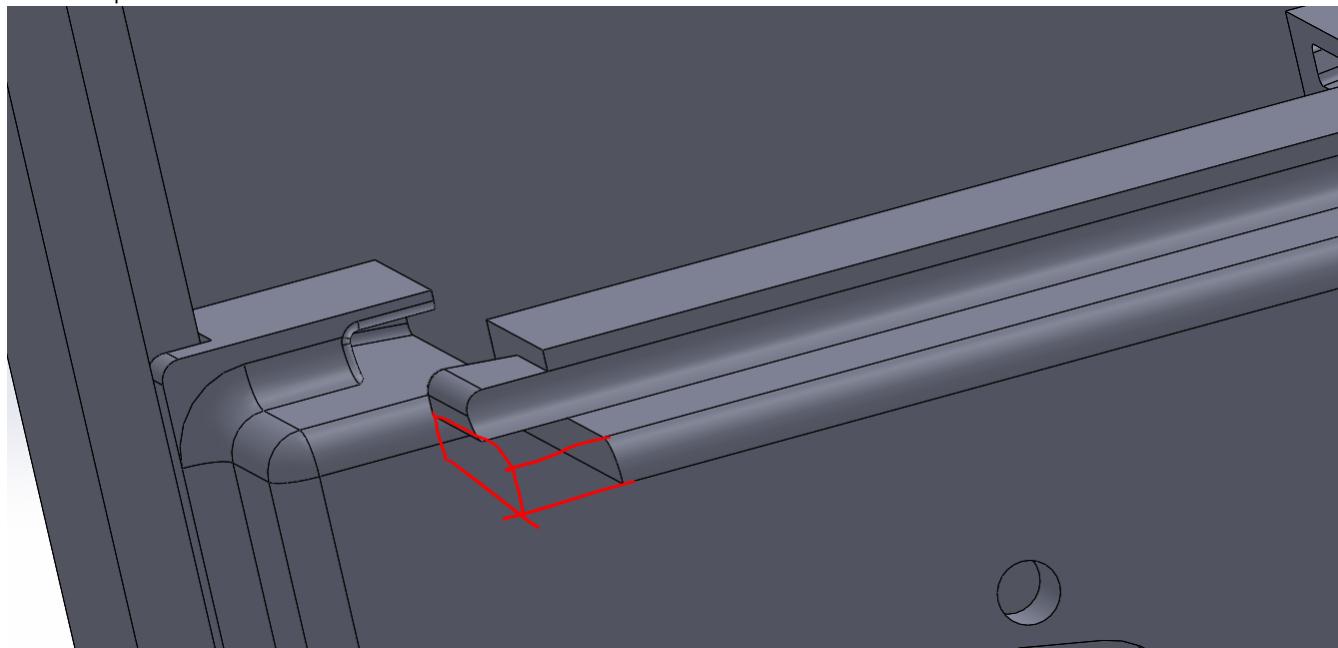
- Wanted to keep a well to collect superglue so that excess superglue is directed away from other parts
- Kept slant of the "lock", while simplifying the lock shape





Iteration 3 Feedback

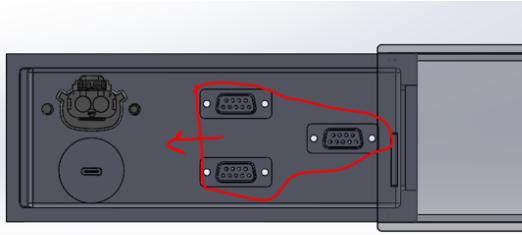
- Should try extending the sides all the way to the edge of the overhang so that no support material is required when printing the glue-on piece



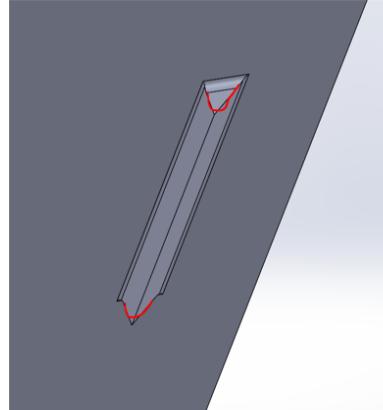
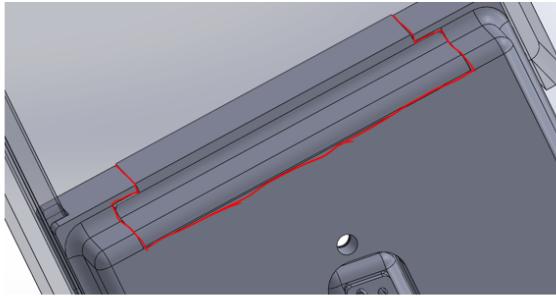
Redesign Iteration 4

- The feedback changes were made

Iteration 4 Feedback



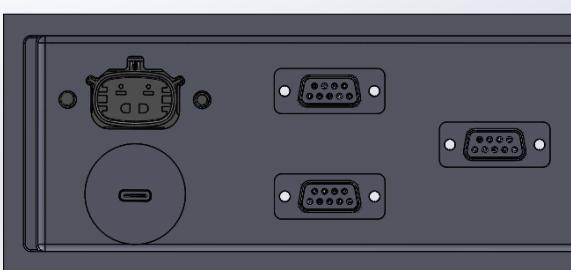
- Move these 3 connectors to the left a bit just to make sure the cable for the right most connector doesn't get blocked by the cover.
- Add 0.5mm clearance around the glue-on piece so that the glue has a place to sit in and won't get squeezed out
- Try beefing up the stopper some more since it is the only thing keeping the cover from falling off the port. Again, try to avoid sharp edges and fillets less than 1mm



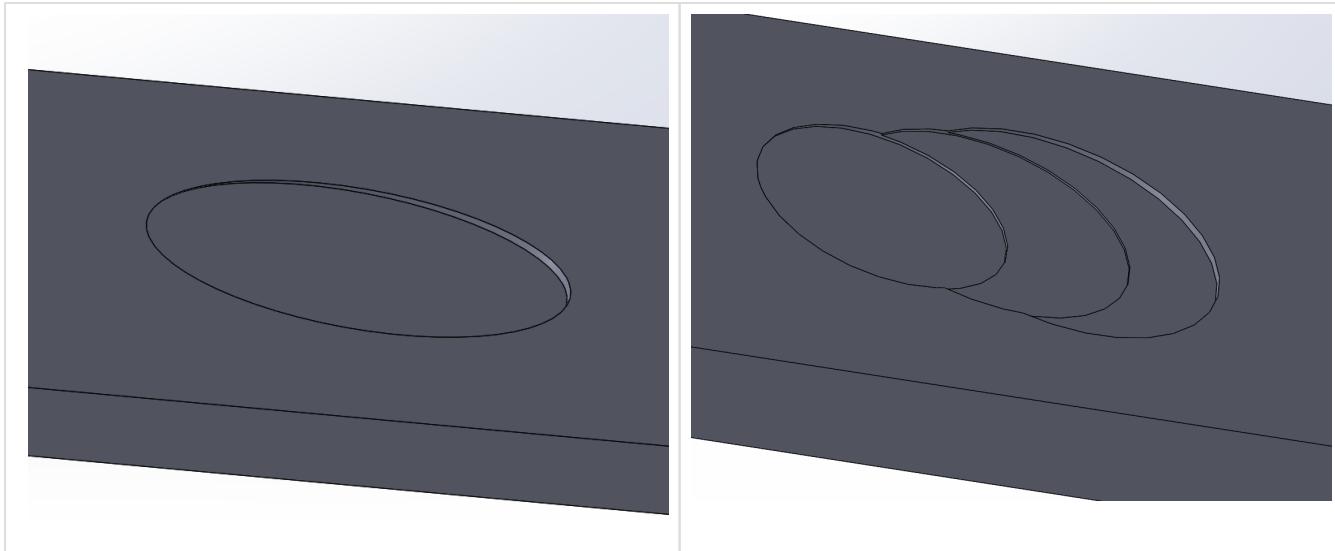
- Also we're gonna have to design in some sort of groove or handle for the passenger to easily slide the cover open. For this, try not to have anything protrude from the flat side of the cover because right away that will make printing more difficult

▼ Redesign Iteration 5

- The ports were shifted to the left, and the stopper was beefed up



- 2 sample designs for grooves on the cover



After the fifth update, the port housing and cover design seemed to be finished, and was uploaded to GrabCAD. It'll then be prototyped by Renzo to check if any further changes are required, or if it is good to go.

Final Design Images

