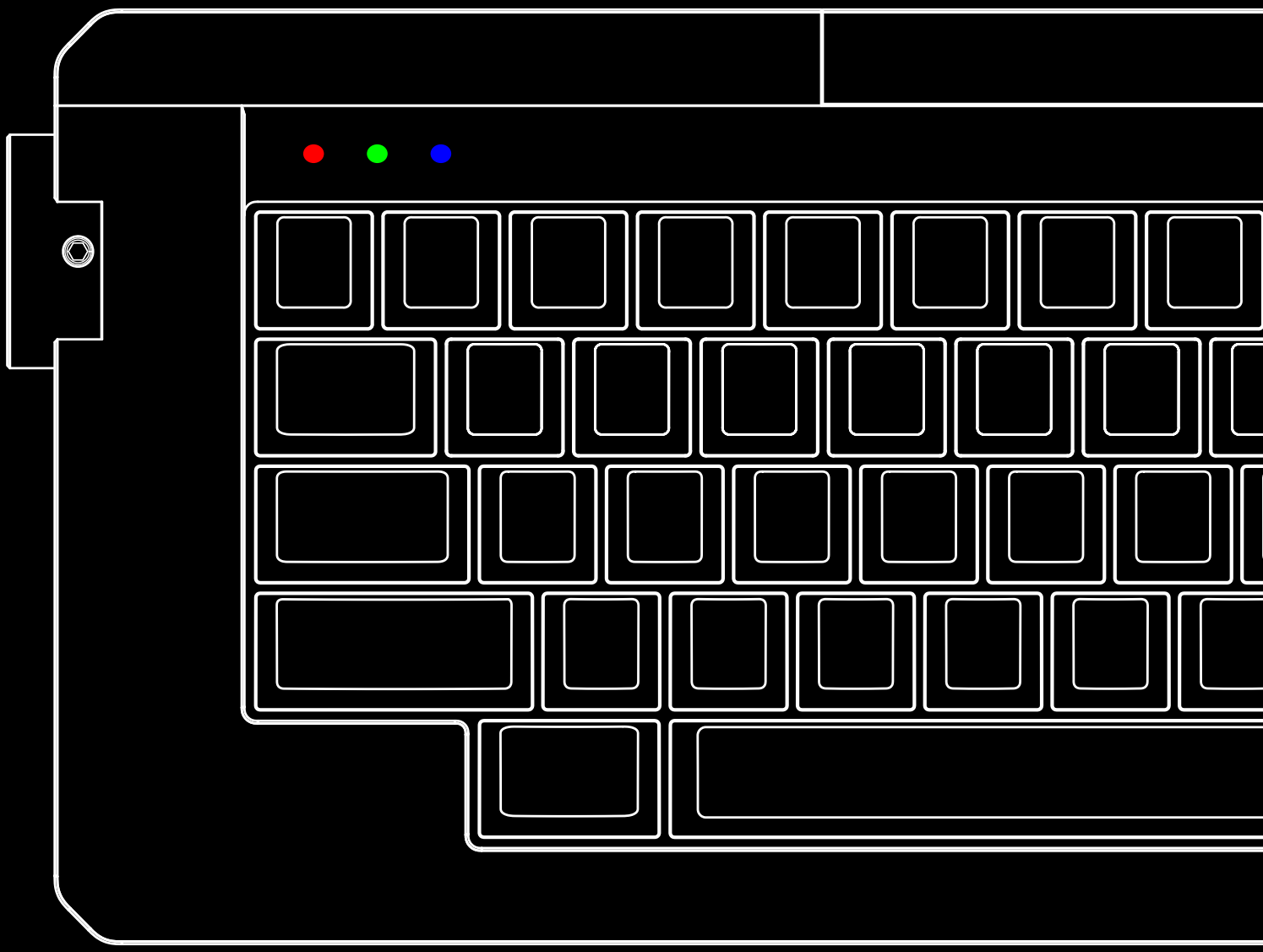

# Re:Gabriele

**Degree Project for Bachelor of Fine Arts in Design**
Main field of study Industrial Design

a project by
**Elias Antonson**

**2021**

LUND UNIVERSITY

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From Lund University School of Industrial Design
Department of Design Sciences

**Project Supervisor:** Senior Lecturer **Charlotte Sjödell**

**Examiner:** Professor **Claus-Christian Eckhardt**

**Course Supervisors:** Professor **Claus-Christian Eckhardt**, Lecturer **Anna Persson**, Senior Lecturer **Jasjit Singh,** Senior Lecturer **Charlotte Sjödell**

**2021**

**ISRN: LUT-DVIDE/ EX--21/50522-SE**

LUND UNIVERSITY

## Abstract

Re:Gabriele is a project that explores historic inspiration in modern products, as well as extending product longevity through user connectivity. The aim of the project is to produce a modern keyboard inspired by the Gabriele 7007L, a 1980's electric typewriter produced by german brand Triumph Adler. The final product is shaped through a process incorporating old values and details into a product produced with methods and materials from a modern context.



## Sammanfattning

Re: Gabriele är ett projekt som utforskar historisk inspiration i moderna produkter, samt förlängd livslängd av produkter genom koppling till användaren. Målet med projektet är att utveckla ett modernt tangentbord inspirerat av Gabriele 7007L, en elektrisk skrivmaskin producerad av det tyska företaget Triumph Adler på 1980-talet. Slutprodukten formas genom att blanda gamla värderingar och detaljer med metoder och material från ett modernt sammanhang.

# Table of CONTENTS

# PART 1: INTRODUCTION

# THE PROJECTS INSPIRATION

The Gabriele 7007L is an electric typewriter, produced by Triumph Adler in the late 1980s. Allthough hugely popular at its birth, over the years it lost its relevance, and eventually fell into oblivion. But, over thirty years later, this typewriter started to regain the attention of others. As it turns out, the keycaps on the keyboard part were removable, and usable on modern keyboards.

It was in this context that I first stumbled upon the Gabriele 7007L. And I could not understand how someone would take just the keycaps of this wonderful machine, and throw the rest away. A question, which eventually turned into this project, was asked; how might the form and values of these old electronics be turned into objects that are still relevant today?


*Gabriele 7007L*

# “HOW CAN THE DESIGN LANGUAGE OF THE 80’S-90’S TRIUMPH ADLER TYPEWRITERS BE TRANSLATED INTO A MODERN INPUT DEVICE?”



## PROJECT BRIEF

This is the question which started the entire project; how a previous design archetype can be used to inspire a modern object. From the beginning, the aim was never to make an object for the 80’s - rather the contrary. Thus, the projects goal was set to use the expertice and taste of a previous age, and put it into a modern context.

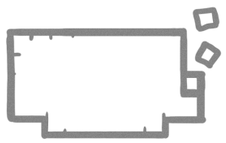
The journey to achieve this goal was set by taking inspiration from the proportions, functions and aesthetics of the past era, and looking at them through the filter of todays look on form, materials and manufacturing techniques.

Since the 1980’s, many new technological advances have been made as well, such as more sofisticated data transfer and threadless communication. Looking further into this was also an integral part of turning the final product into an object made for the 2020’s.

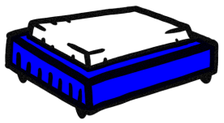
# DEMARCATIONS

A standard keyboard can generally be divided into two main parts, the keycaps and the case. As discussed earlier in this report, an important part of this project is to give the possibility of induvidualisation of the product. Therefore, the board will be built around standardized interchangable keycap sets, which can be decided by the user to give their personal flair.

This means that this project will be focusing on the case, as well as the internals that goes into the workings of the keyboard. In sketches or images showing the keyboard, it will therefore have either standardized blank keycaps or none at all, to give focus on the part that is being developed - the case.



KEYCAPS



CASE

# COVID-19

It is hard to avoid mentioning the spread of the Covid-19 virus, seeing at how big of a role it has played during the months this project has spanned. Parts of the process which would otherwise have been natural to do with the help of models or built prototypes have had to be done digitally or on paper, in order to adapt to the precent circulmstances. The most obvious result of this  is the lack of a final prototype arriving in time for the documentation. This is discussed in further detail on page 69.

# A short history of

TA Triumph-Adler

Founded in 1896, Triumph started out as a motorcycle manufacturer, based in Nuremberg, Germany. In 1909, their first typewriter was made after the aquisition of a closed typewriter factory.

Throughout the 1900's, Triumph Adler saw a gigantic rise, with a fall just as big before eventually being forced to close down their typewriter production. However, rewinding just a few years before that, a completely different Triumph Adler can be seen;

## The golden era

**1896:** Deutsche Triumph Fahrradwerke AG is founded in Nuremberg.

**1909:** Triumph starts manufacturing typewriters.

**1953:** Triumph is taken over by Max Grundig, merged with Adlerwerke, and renamed Triumph-Adler.

**1968:** Litton Industries Inc. becomes the company's new majority shareholder.

**1979:** Triumph-Adler is acquired by Volkswagen AG.

**1986:** Italian Olivetti group takes over the company.

**1994:** Triumph-Adler is sold and becomes a management holding company.

**1997:** The typewriter production in Frankfurt/Main is closed down.

**2000:** Triumph-Adler declares imaging and output solutions its core business.

Calling the period of 1986-1994 Triumph Alder's golden era comes with one reason.In 1986, Triumph Adler was aquired by Italian tech manufacturer Olivetti, bringing a completely new approach to their business.

# olivetti

Founded as a typewriter company in Italy in 1908, Olivetti stood out through the 1900's for their large emphasis on design and form.

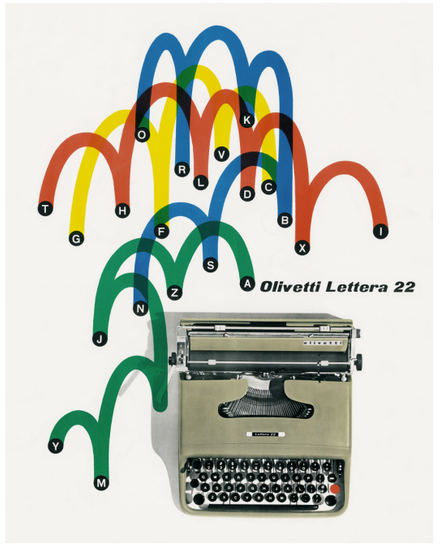
In 1976, Olivetti released the worlds first Electrical Typewriter, the ET 101. Fast forwarding ten years, in the late 80's, Olivetti had turned into one of Europe's biggest manufacturers of computers. At their peak they stood as a direct competitor to companies of the likes of Apple and IBM.

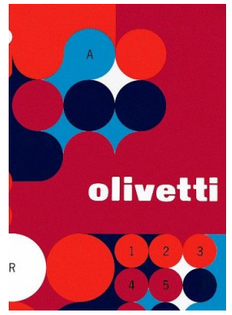
During this time, Triumph Adler had seen a decline in sales, mostly due to their multifaceted way of doing business. In fact, their typewriter division was the only one turning up a profit. After being bought by Olivetti, Triumph Adler was made into their headquarters for office machines, and released several computers and electric typewriters with the help of the design team from Olivetti.[1]

And among these were the Gabriele7007L

[1] *Grant, T. (2003) "**International directory of company histories. Vol. 48**" p.382 Book, Detroit. (ISBN 1-55862-466-X).*







# TARGET GROUP: ENTHUSIASTS

The target group for the project is what can be described as “enthusiasts”. This does not have to be someone interested in typewriters or keyboards per se. The description mostly refers to a person with a large interests in the products they buy. Someone who wants a personal connection to the things around them, and does not mind the extra money or tinkering to reach that goal.



# PERSONALISATION

A large part of the project relating to this targeted group comes from the ability to personalise the final product. By being able to get a product that is tailored to each users preferences, the aim is to get a final result that is more carefully looked after, thus elongating the products life. The ability to personalise keyboards is also an important part for already existing keyboard enthusiasts and collectors. This mainly comes from the form of two areas, from the feeling  of typing, and the aesthetics of the board.

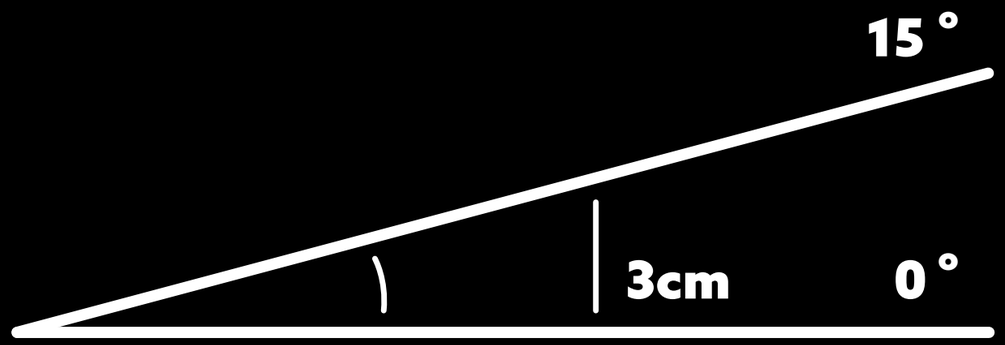
*Gear Patrol (How to Buy a Mechanical Keyboard) 2020, Chandler Bondurant*

# ERGONOMICS

There has been many breakthroughs in the field of ergonomics since the 1980's, which means that the things todays input devices shows a drastic difference. The ISO 9241 standard for ergonomics of human-computer interaction was introduced in 2006 by the International Organization for Standardization. Looking at the 400 directive which is specified for physical input devices, a few guidelines can be found related to keyboard ergonomics.[4]

In the illustration to the right hand side of this spread the two main takeaways can be found; The angle of the keyboard needs to be in some way adjustable and be between 0-15 degrees. Furthermore the middle row of keys must sit at a maximum of 3 centimeters over the bottom of the keyboard. These points were later taken in mind when continuing with the design of the keyboard.

[4] *iso.org/standard/38899.html*




ISO 9241-410

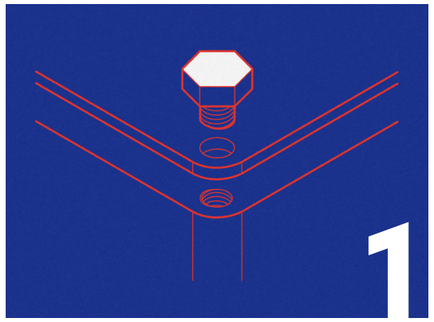
# ENVIRONMENTAL GUIDELINES

During the run of this project, four main principles of environmental design were developed, each in some way relating to the goal of elongating the products life. The goal was thus to reduce the products footprint by exploring a different way of developing consumer electronics - through care and repair, rather than as consumables.[2] These four principles were then later revisited in the products later stages in order to confirm wether they had been succesfully achievied or not. Inspiration for these principles were taken from the 12 principles of green engineering developed by Paul Anastas and Julie Zimmerman.[3]

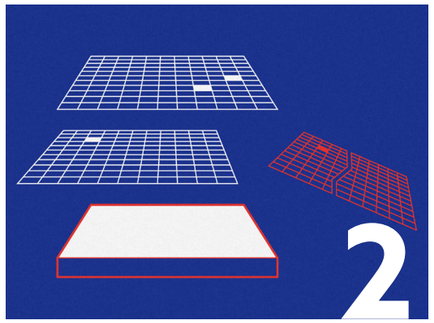
[2] *Kaddoura, M., Kambanou, M., Tillman, A., Sakao, T. (2019) "**Is Prolonging the Lifetime of Passive Durable Products a Low-Hanging Fruit of a Circular Economy?: A Multiple Case Study**" Artikel i tidsskrift, Schweiz. (ISSN 2071-1050).*

[3] *Anastas, P.T., Zimmerman, J.B. (2003) "**Design Through the 12 Principles of Green Engineering**" Uppsats, Nottingham. (ISSN 1937-4178).*

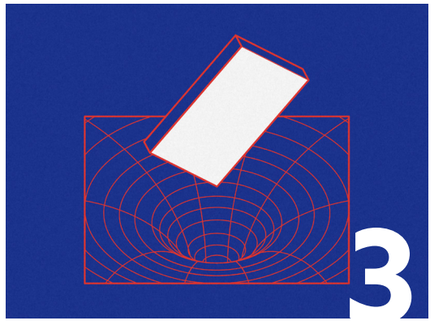




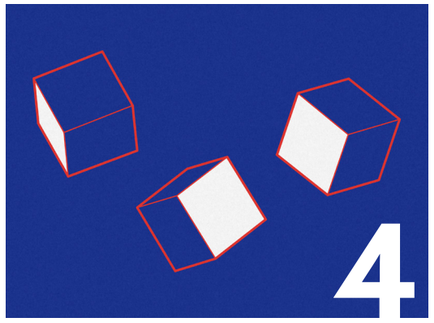
## 1 Design for disassembly



## 2 Replace and customize



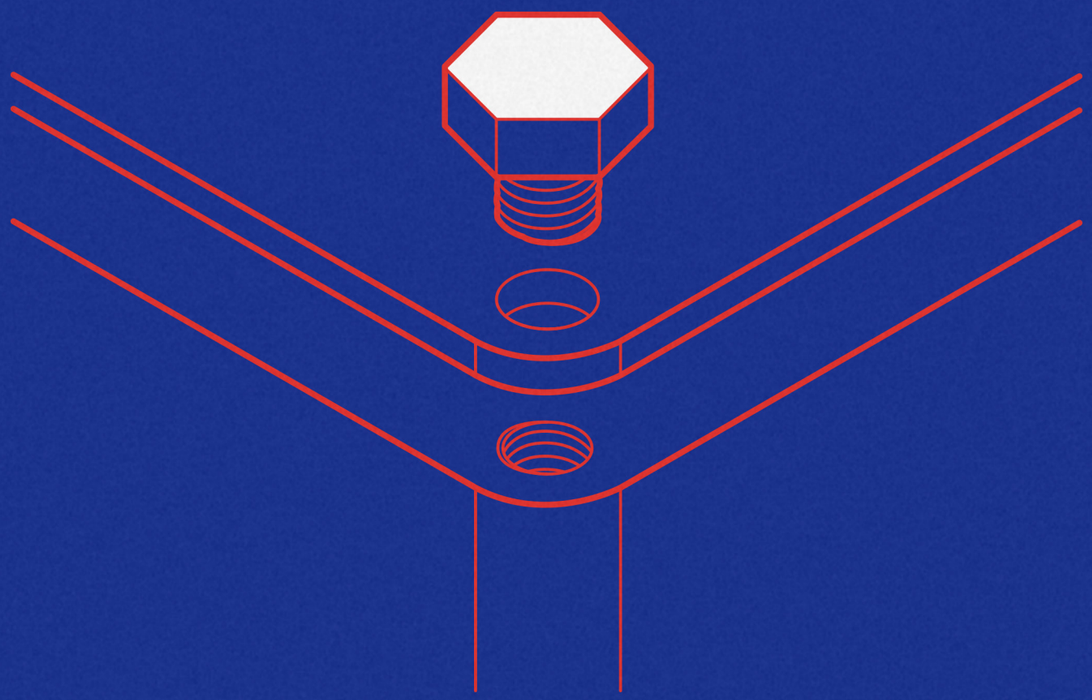
## 3 Counteract immortality



## 4 Material uniformity

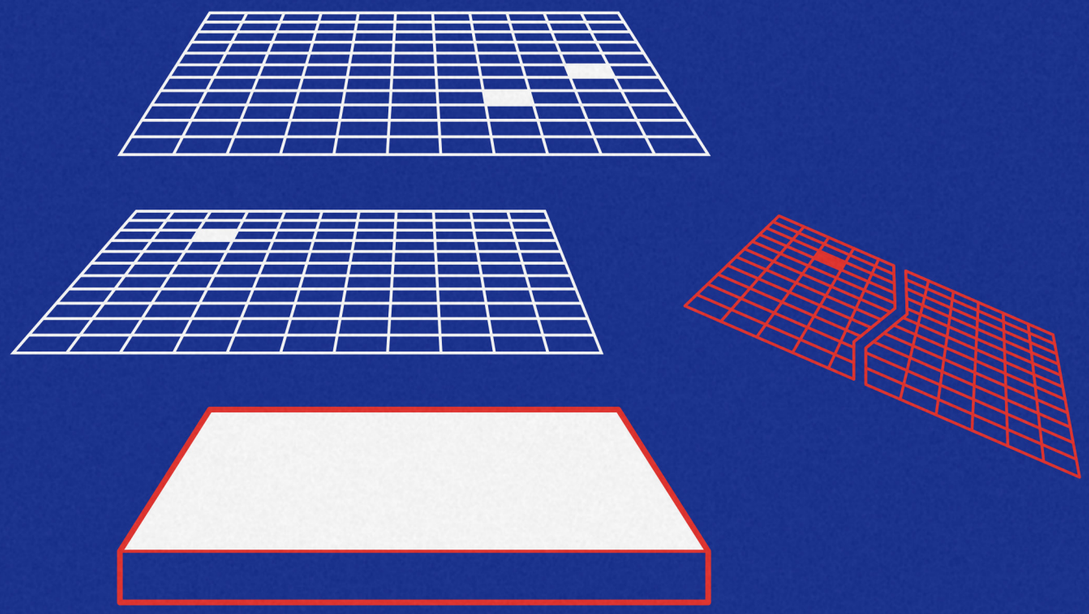
# 1 Design for disassembly

The first principle comes from a wish of easy access to the inner workings of the product, as well as for ease of recycling and eventual replacements. The aim of this principle thus came to be to develop the product without the use of any permanent fastenings.



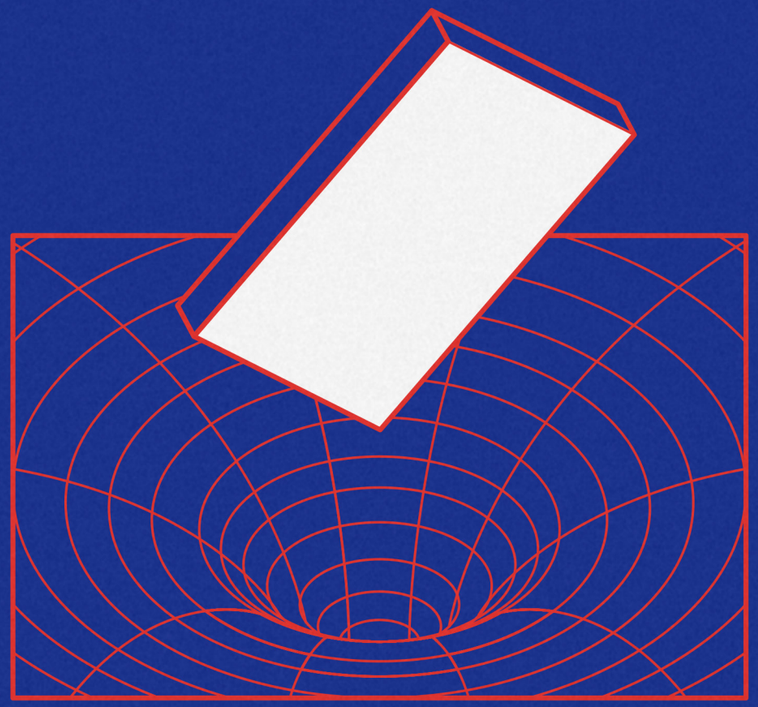
# 2 Replace and customize

The second principle comes from a desire to create a product which encourages customizability and repair. This relates to the first principle in the sense that all parts should be easily dissasembled, but also interchangable in an easily accessible way.



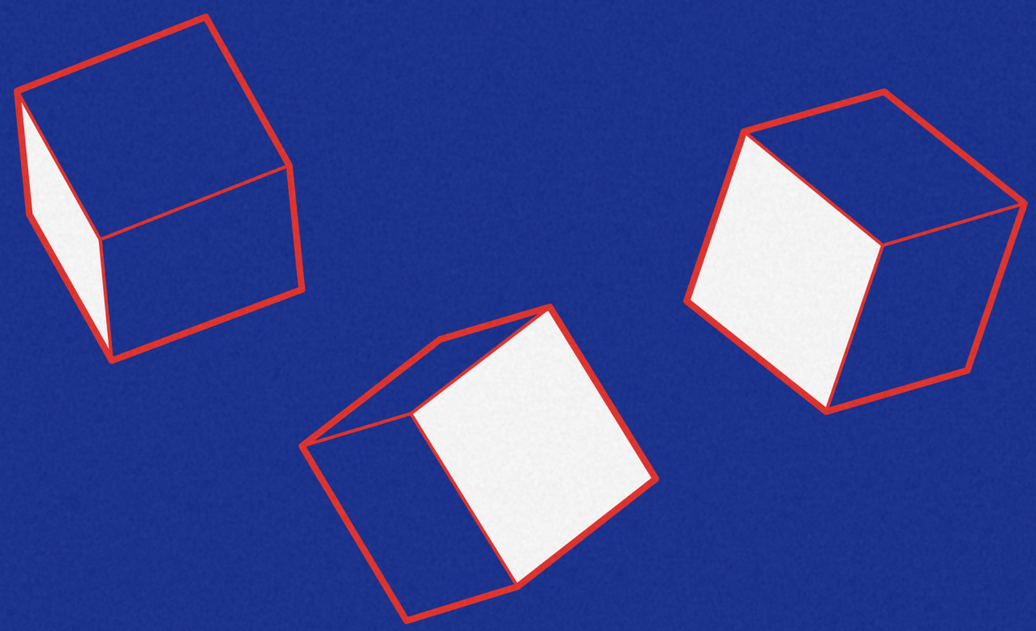
## 3 Counteract immortality

While an increased product life is one of the main focuses of this project, it is an important demarcation to not strive for immortality. In practicality, this means using materials and treatments that can be easily removed, recycled, and which won't outlive the product.



## 4 Material uniformity

The last principle aims to keep the material choices in the product as uniform as possible. This is to ease both manufacturing and the taking care of the product at the end of its life.



# PART 2: SYNTHESIS

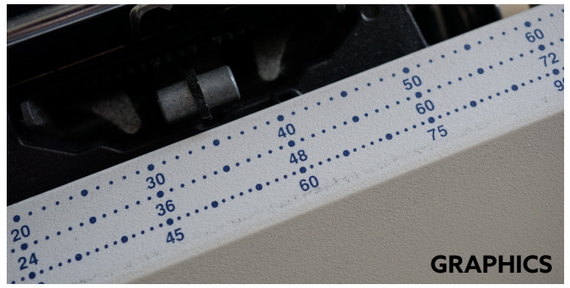

# DESIGN LANGUAGE ANALYSIS

This is how the synthesising process started - examining and documenting every detail possible on the Gabriele 7007L. This analysis ventured both into functional as well as the aesthetic parts of the typewriter, and all were written down into corresponding lists, no matter how small.

The next step of this process came through gathering all the information taken from the original typewriter, and contextualizing it in form. By working this way, the features and forms that naturally worked with the constraints and brief set from the beginning of the project could be worked out, and further developed into more concrete concepts.

While not all functions were later included, features such as the handle, side wheel and inward slant ended up getting a large presence in the further development of the project.







## Layout 1

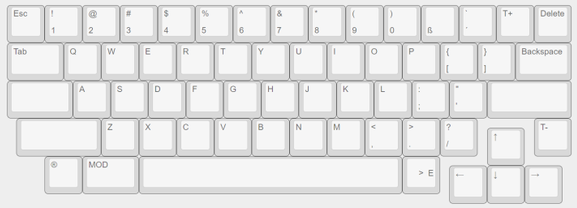
The first layout is a loose take, closely resembling modern keyboard layouts.

## Layout 2

The second layout is close to the original, but lacks some modern functions.

## Layout 3

Layout three achieves a good mix, but has a few awkward compromises.



## Layout 4

Layout four is close to ideal, but needed some cleaning around the arrow keys.

# KEYCAP LAYOUT

The layout of the keyboard was decided upon before the development of the keyboards form began. Since this serves as the basis silhuette of the final board, it is important to get exactly right before further development has begun. The finished layout is composed only of keycap sizes found on the Gabriele 7007L, meaning that it can be potentially customized to use only the keycaps taken from it. It also sticks out from other keyboards on the market due to the placement of the arrow cluster that can not be seen on any current designs.

**"Really nice compact looking ratio"**

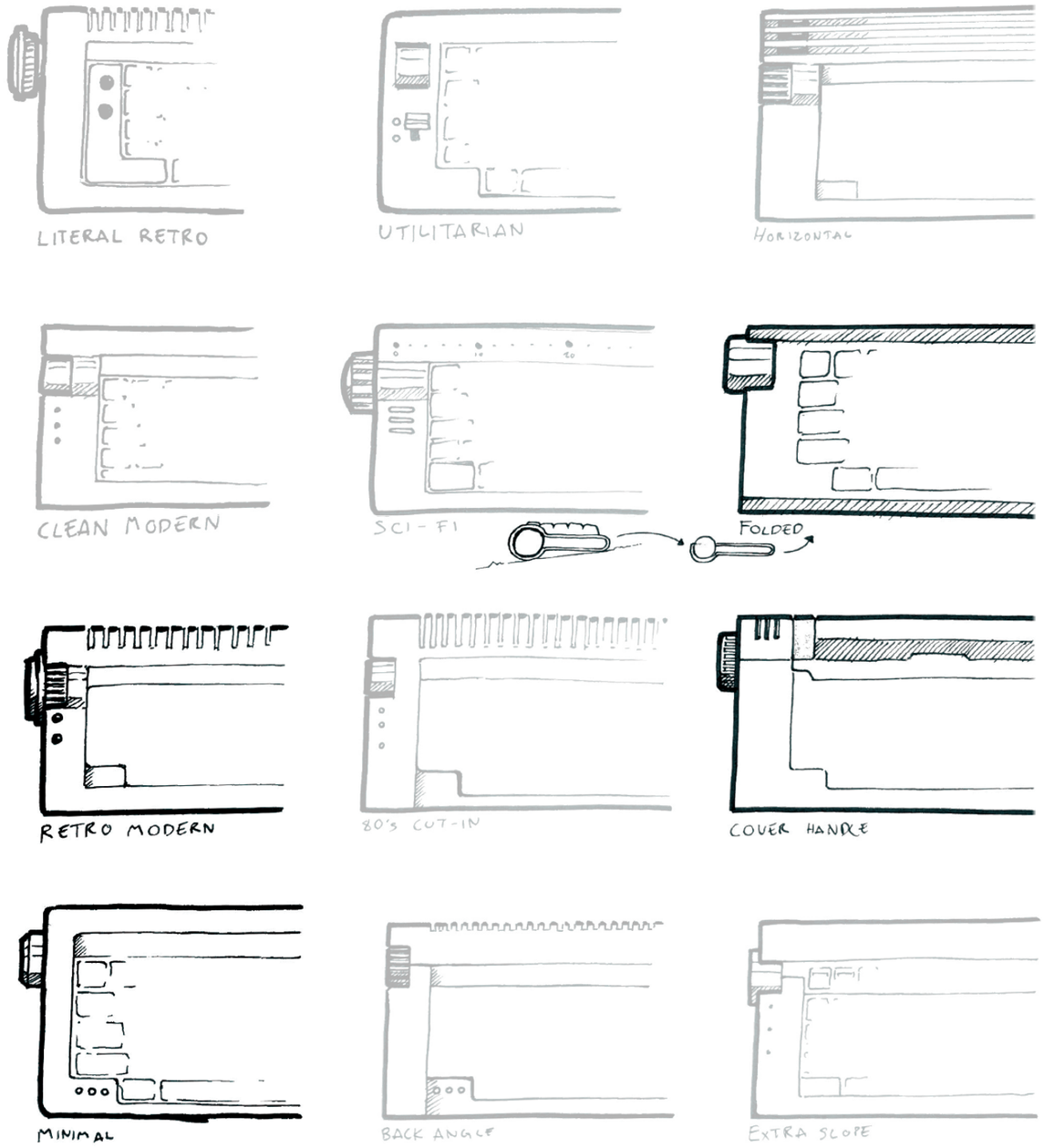
**"Great from an interface point of view"**

***User interview feedback***

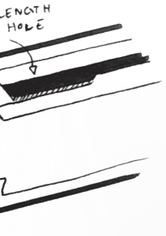
# CONCEPT GENERATION

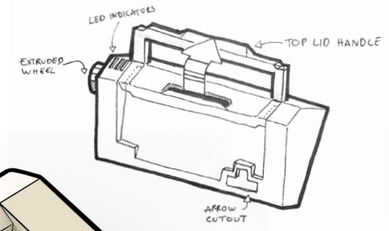
After the completion of the keyboard layout and form language analysis, the next step was to sketch out thumbnail sketches of the translated features. Like previously, both form and function were explored at this stage, integrating new ideas as well as translating others from the old typewriter. This resulted in a wide variety of variants, of which a few were chosen to move forward with.

The chosen variants were then fleshed out further, with many supporting sketches and ideas added. As can be seen on the next spread, 4 complete concepts were made, each made with a different material and feeling in mind. The one that was choosen to continue further with was the concept called “Cover handle” - drawing inspiration from the typewriters dust cover to act as a top handle. The chosen suggested material and manufacturing method of this variant was CNC milled aluminum.

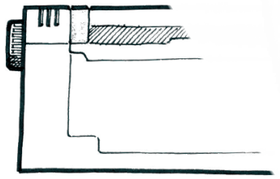


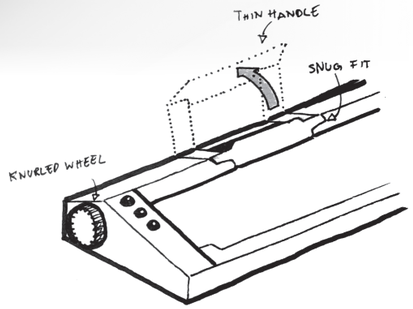
## COVER HANDLE

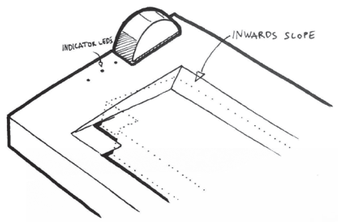


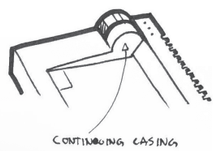





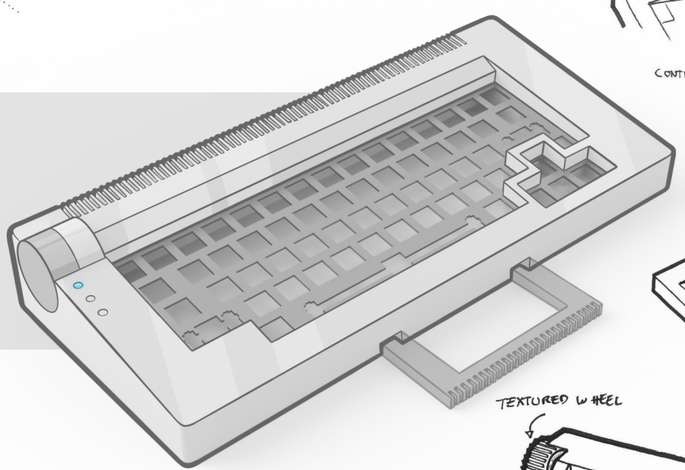



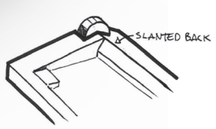


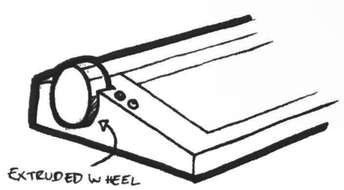



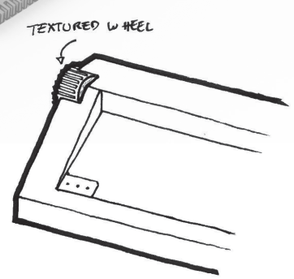




## RETRO MODERN

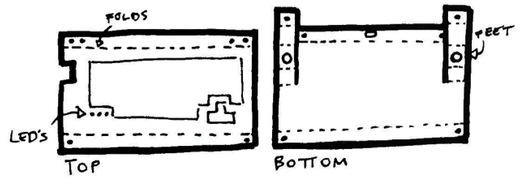


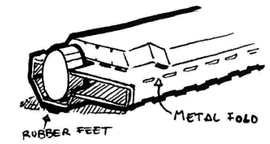


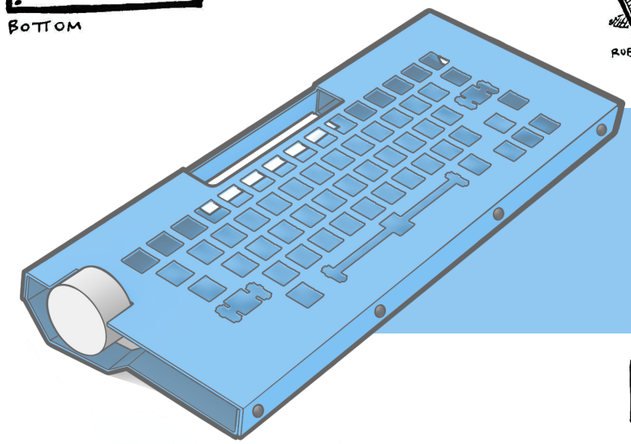



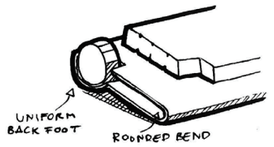


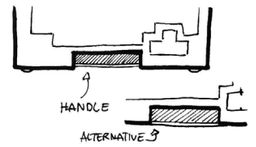



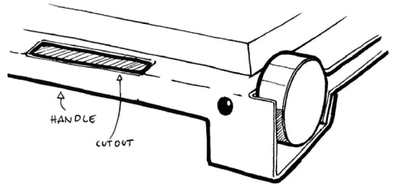



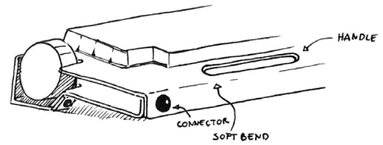



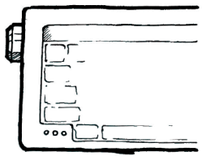
## FOLDED

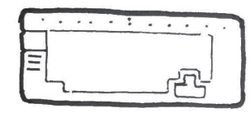


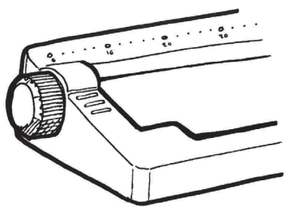



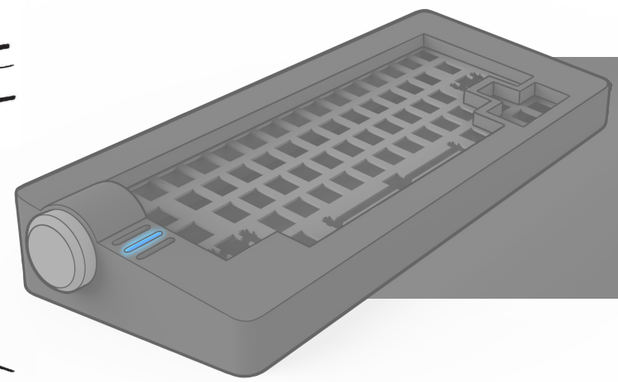



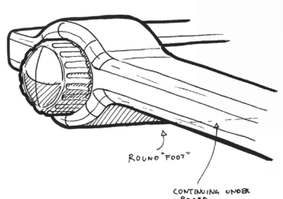



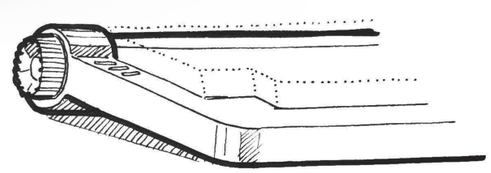


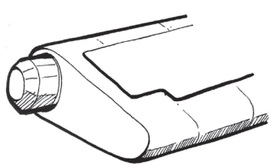


## MINIMAL



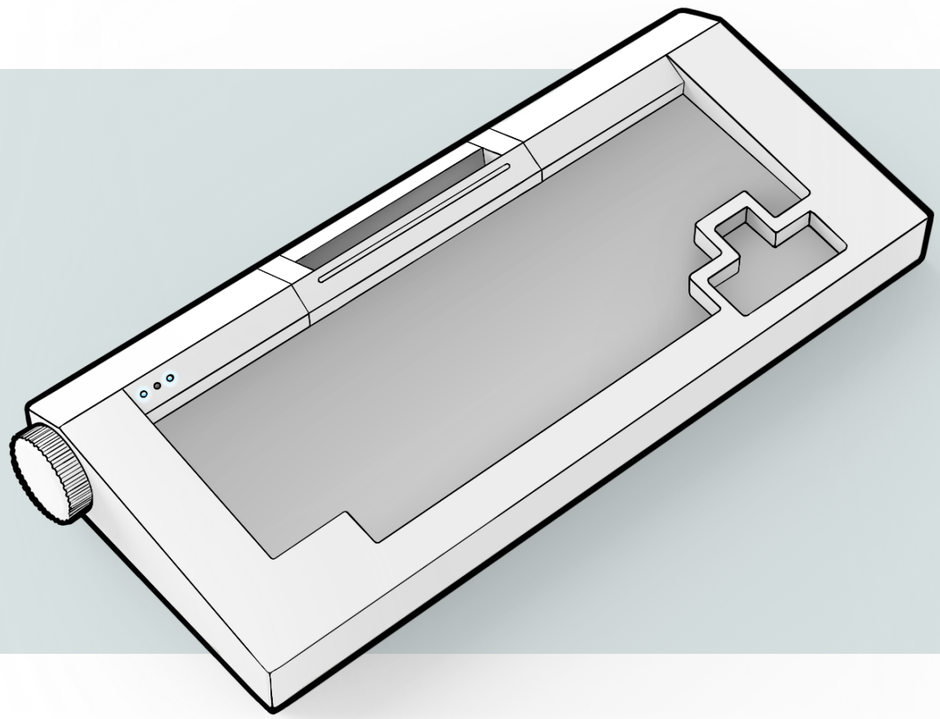




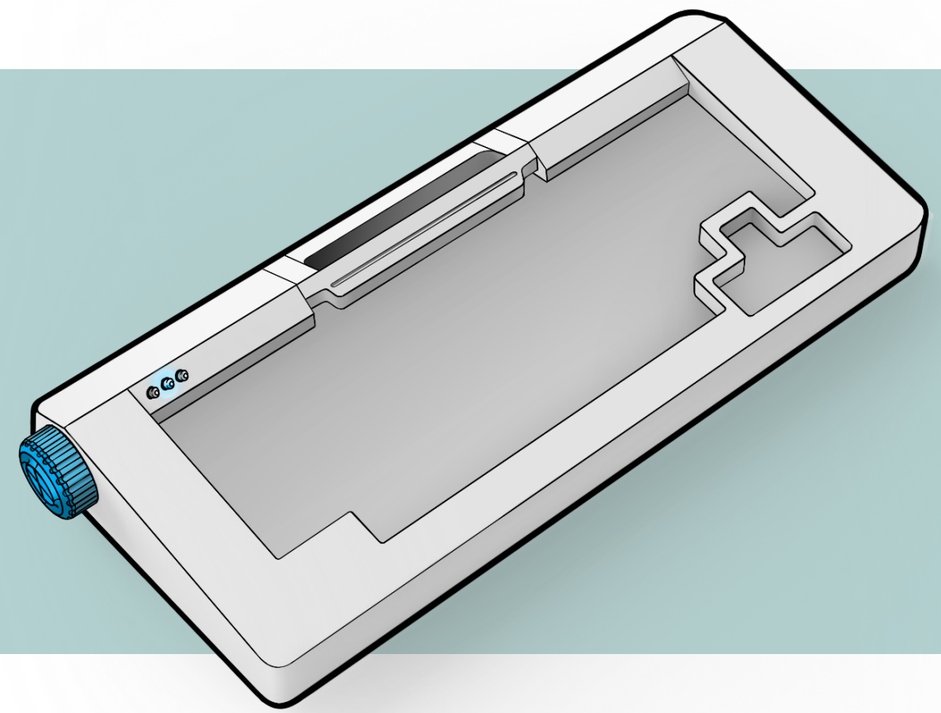
## CONCEPT 1 - EDGY

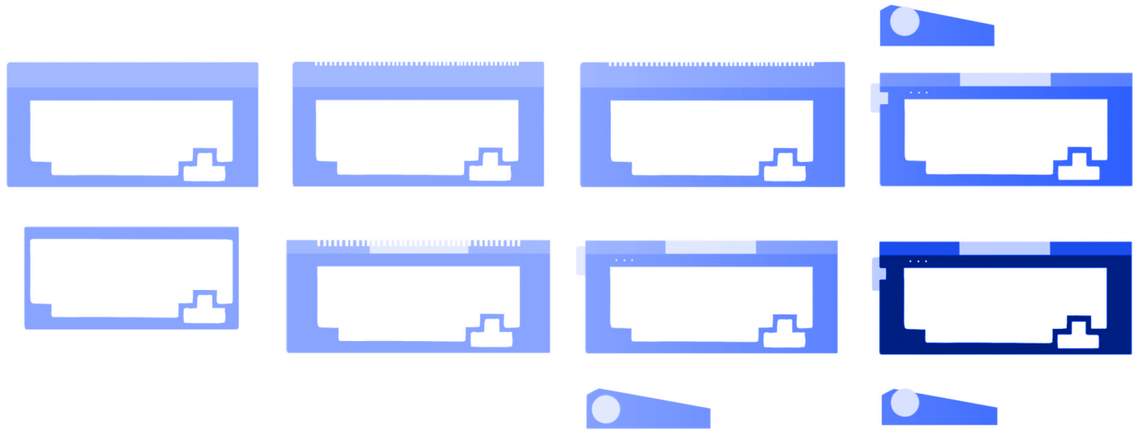
After deciding on “Cover handle” as the choosen concept, it was further developed into two variants. The edgy variant features sharp edges and a geometric feeling, where details are kept to a minimum.



## CONCEPT 2 - ROUNDED

The second concept features a bit softer shape, with a plastic detailed side wheel. Another detail is the bigger indicator LED’s pertruding out of the back angle, as well as the more detailed handle.





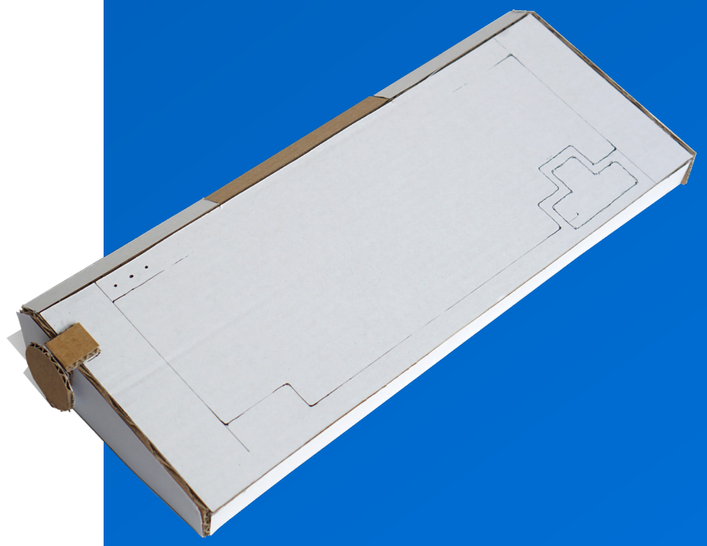
## PROPORTION SKETCHING

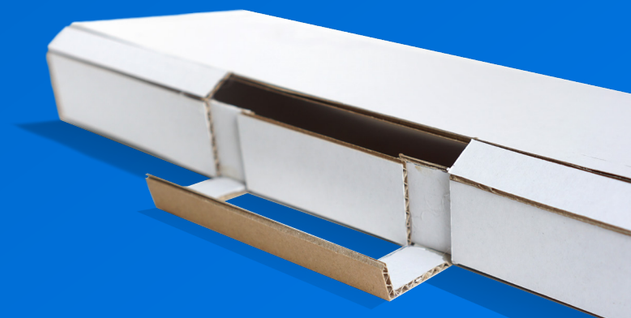
After the two concepts variations were made, there was still a lot to do regarding the shape - mainly that it felt somewhat uneven. To move forward with this, several top-view sketches were made, exploring the proportions and sizes of the board. This stage also led to a change in the handle placement, which proved much more intuitive to use, as well as giving a more visually striking and iconic silhouette.



## SKETCH MOCKUPS

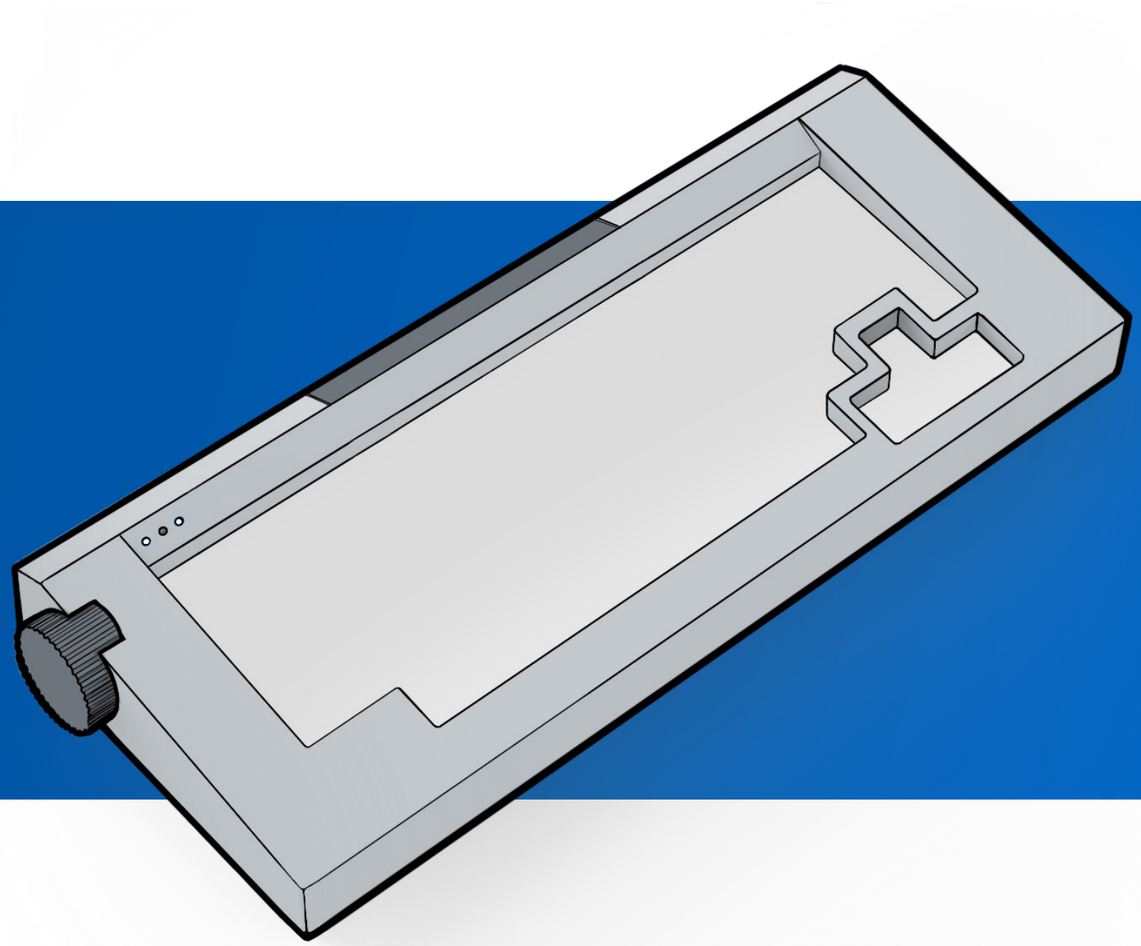
During this stage a range of paper mockups were made as well to test the size, height and angle of the board, which was subjected to user tests and feedback. This led to the board being lowered, as well as changing the size of the handle to better fit its needed function. These tests also led to the wheel placement being re-designed in a way that made it easier to reach and use.

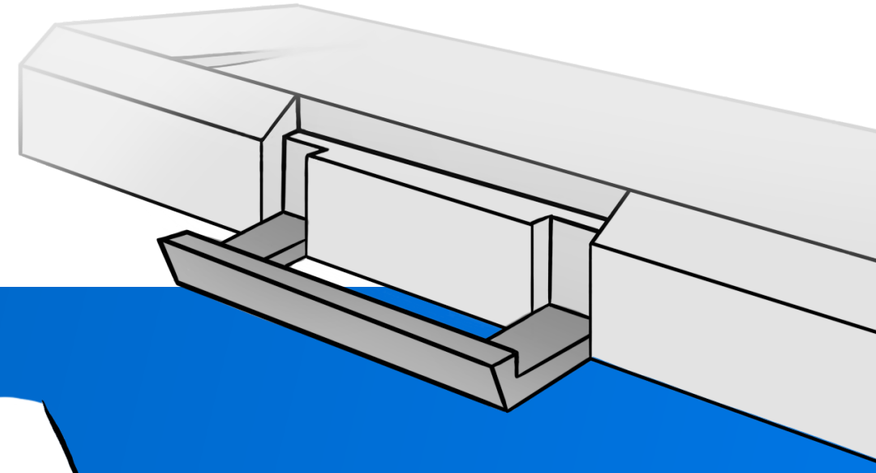



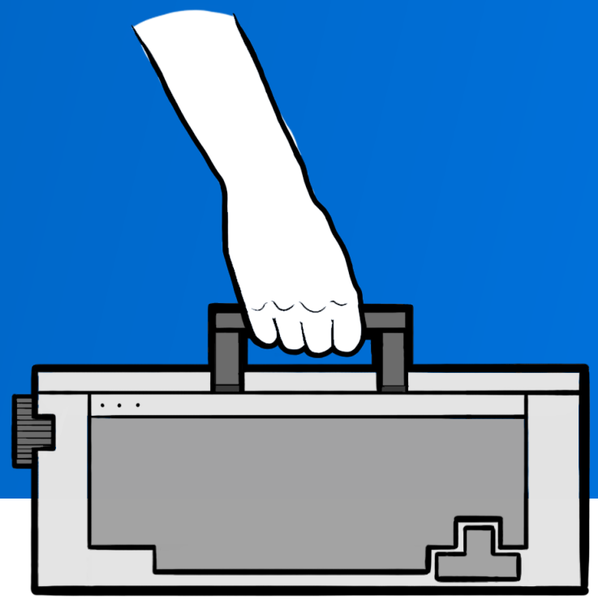


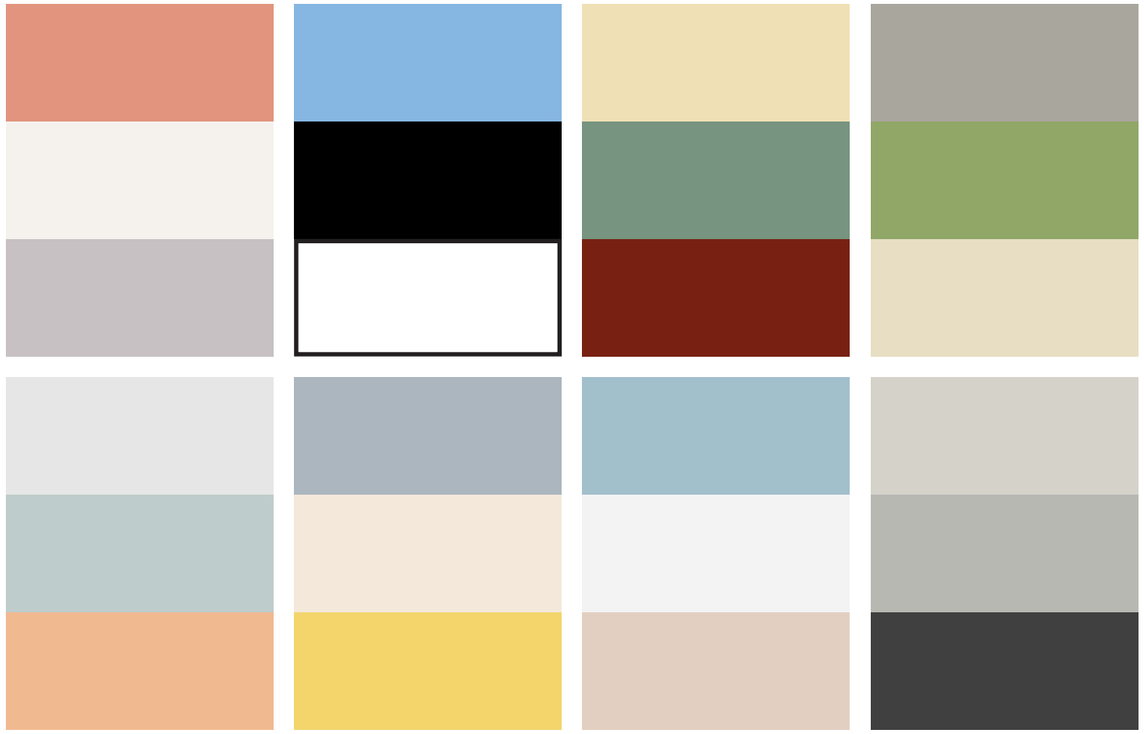
# “FINAL” SKETCHES

This is the final sketches that were made - however, the board continued development in several areas during its development into a manufacturable object. However, the general shape and feel of the board were decided at this point, at a level where it was possible to move forward to the next steps in the process.





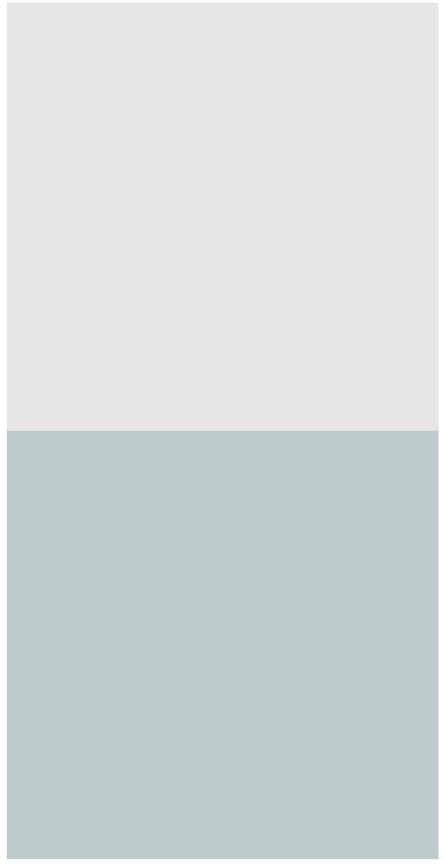




# COLOR TESTING

After the form of the board were decided, a lot of both past and current day products were studied to explore color and pattern variants. This was a big eye opener, seeing how seemingly small differences in shade and saturation of color made a huge difference in the final outcome of the product.

As earlier stated, the aim of the project was to be able to offer a base which could be customized however the user would like through the use of added keycaps in different shapes and colors. Thus, a color scheme was chosen that would give the case its own identity, while also working with a variety of colors. To the right the final scheme is displayed; natural grey together with matte blue.

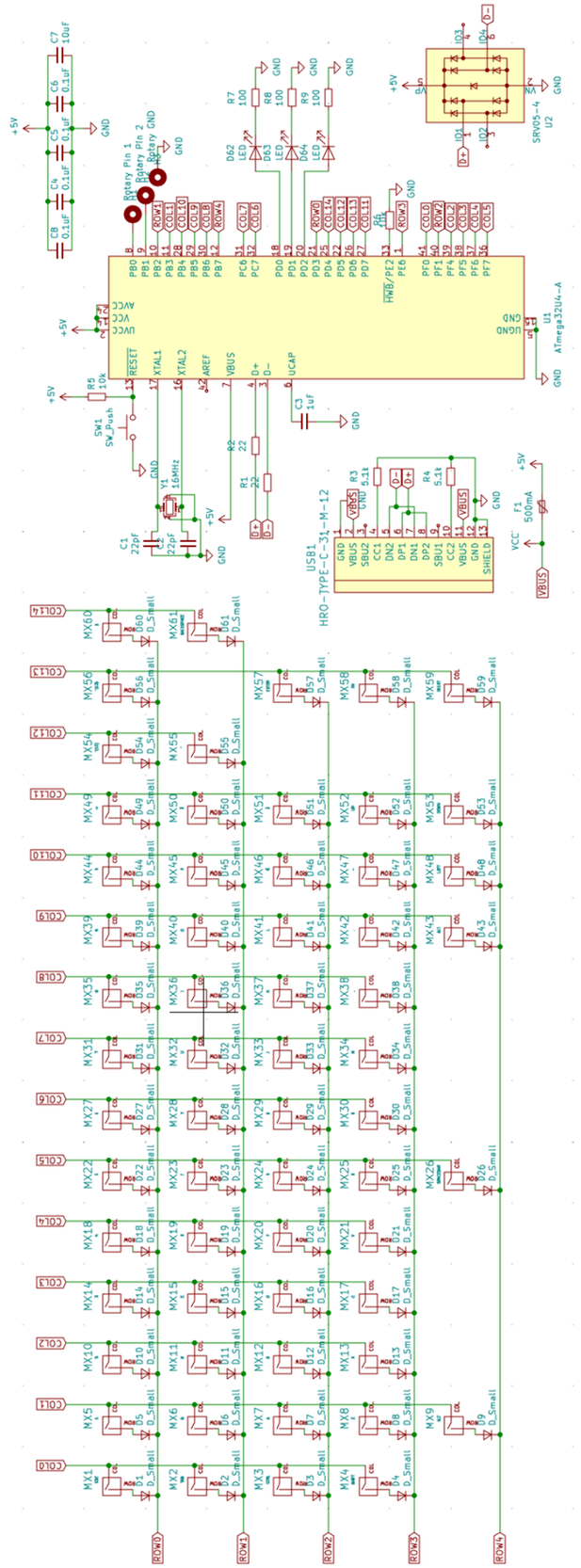


# SURFACE TREATMENT AND FINISH

Together with the exploration of color variants came a search for the optimal surface treatment and finish of the final piece. At this point the production method had been decided to be CNC milled aluminum. This directly limits the color choices - for instance, white can not be achieved while using anodizing, which was eventually chosen as surface treatment for its durability, cost and low environmental impact. The type of anodizing was decided to be a matte finish, with the metallic look that comes through the anodized metal.

## PCB PLANNING

After the final shape of the board had been decided, it was time to start working on the inner workings of the board. The electronic layout were first sketched out in order to figure out all the connections, before being worked into a final schematic.

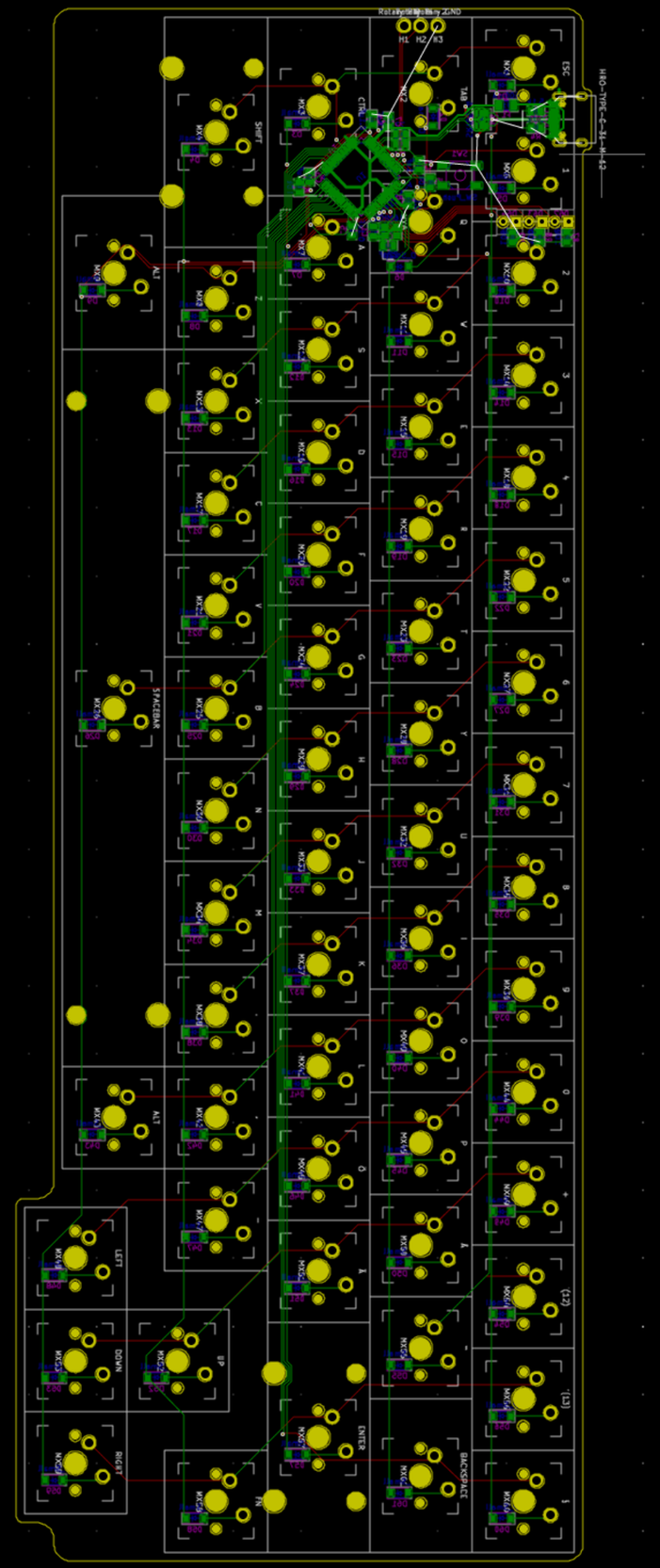



# SCHEMATIC LAYOUT

The schematic layout was reworked in many stages, in order to achieve the required functions of the board. Much emphasis was placed on making the board secure from shocks and electric overloads. Another challenge in this process was the addition of the type C USB, which requires many additional components to work compared to traditional mini or micro usb ports.

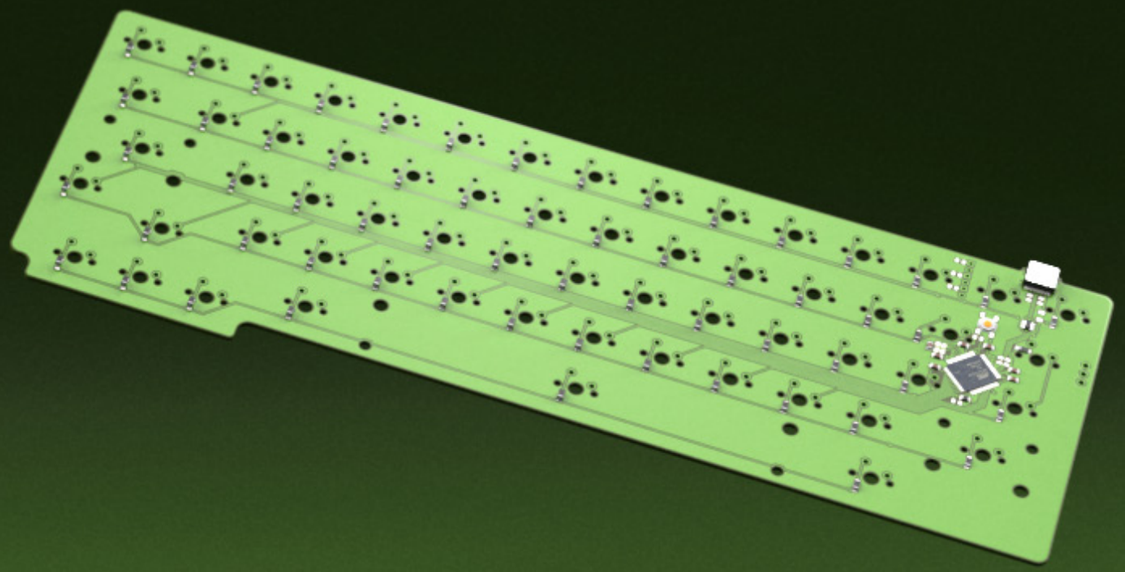
# PCB DESIGN

After the final schematic was made, it was then imported into the making of the PCB lay-out. Both schematic and PCB design was done in KiCad. Seeing as this was the first time that I have worked on a real PCB, many attempts had to be made in order to efficiently route the board, and ending up at a logical layout.

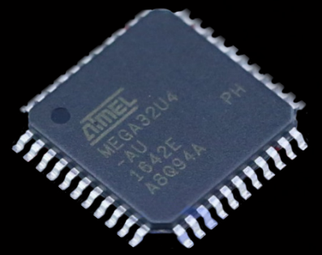


# THE FINAL PCB

And here it is, the final PCB. While I had hoped to be able to test it in real life, Covid resulted in many delays, and the prototype PCB's were stuck in customs in Sweden for over a month. Fortunatley the rest of the board could be developed around this, as the shape could be decided with the possibility of fixing or remaking any functional parts of the PCB.







**1x** ATMEGA32U4 **MICROCONTROLLER**

**1x** TYPE C-3 **USB PORT**

**1x** ELEC K2 **PUSH BUTTON**

**1x** 60V 250mA **FUSE**

**1x** 16MHz 60Ω **CRYSTAL**

**1x** SRV05-4-P-T7 **ESD CHIP**

**61x** 40V 1A 600mV **DIODE**

**1x** 10uF **CAPACITOR**

**1x** 1uF **CAPACITOR**

**4x** 100nF **CAPACITOR**

**2x** 22pF **CAPACITOR**

**2x** 10kΩ **RESISTOR**

**2x** 5.1kΩ **RESISTOR**

**3x** 100Ω **RESISTOR**

**2x** 22Ω **RESISTOR**

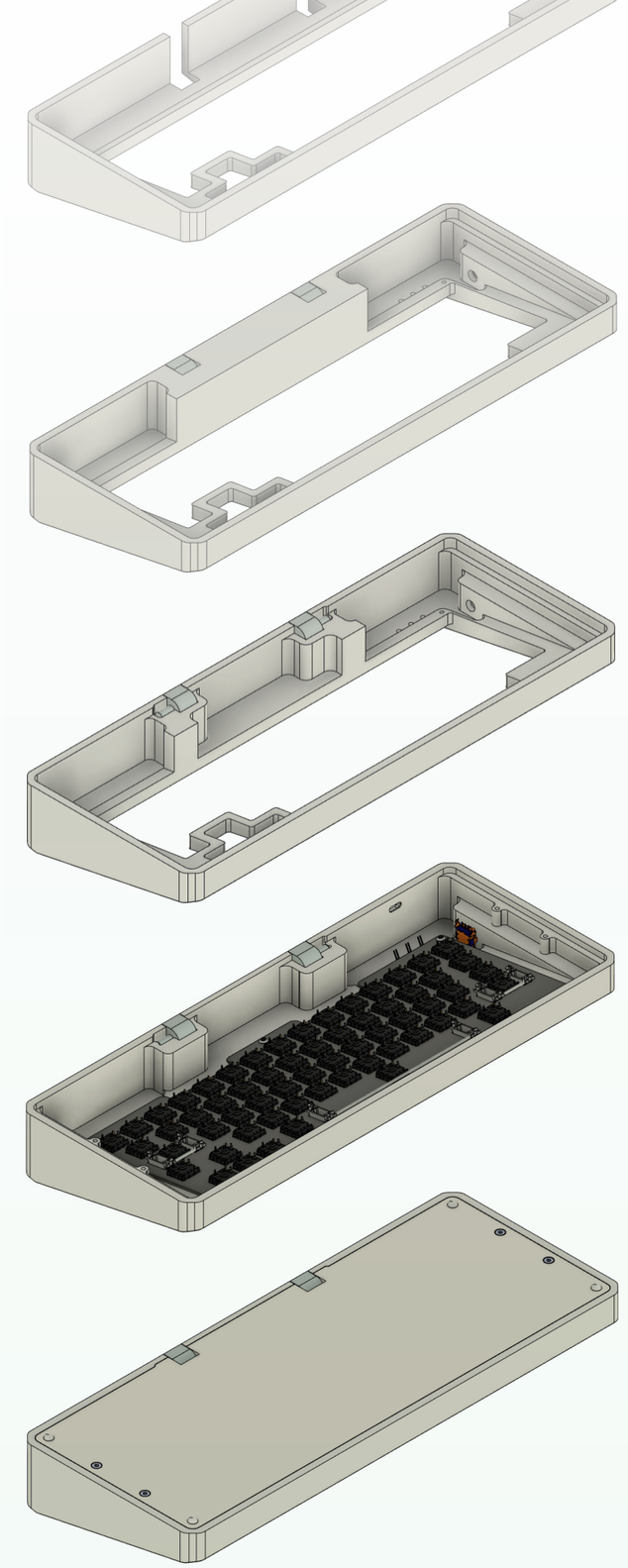
# DESIGN FOR MANUFACTURING

The last stages of the design process was to make sure the board was ready for manufacturing. In this projects case, that was to build it for CNC milling, taking clearances, inner radius and angles in mind. It was also at this stage that the assembly was worked out, placing screws, figuring out mounts for components and parts, and making sure it all fit together smoothly.

This process started with making sure it was functional, and then working to make sure the insides were as tidy and aesthetically pleasing as the outside. It turns out, the cleaner looking it is, there is a high possibilty it is also the simplest and cheapest to produce.

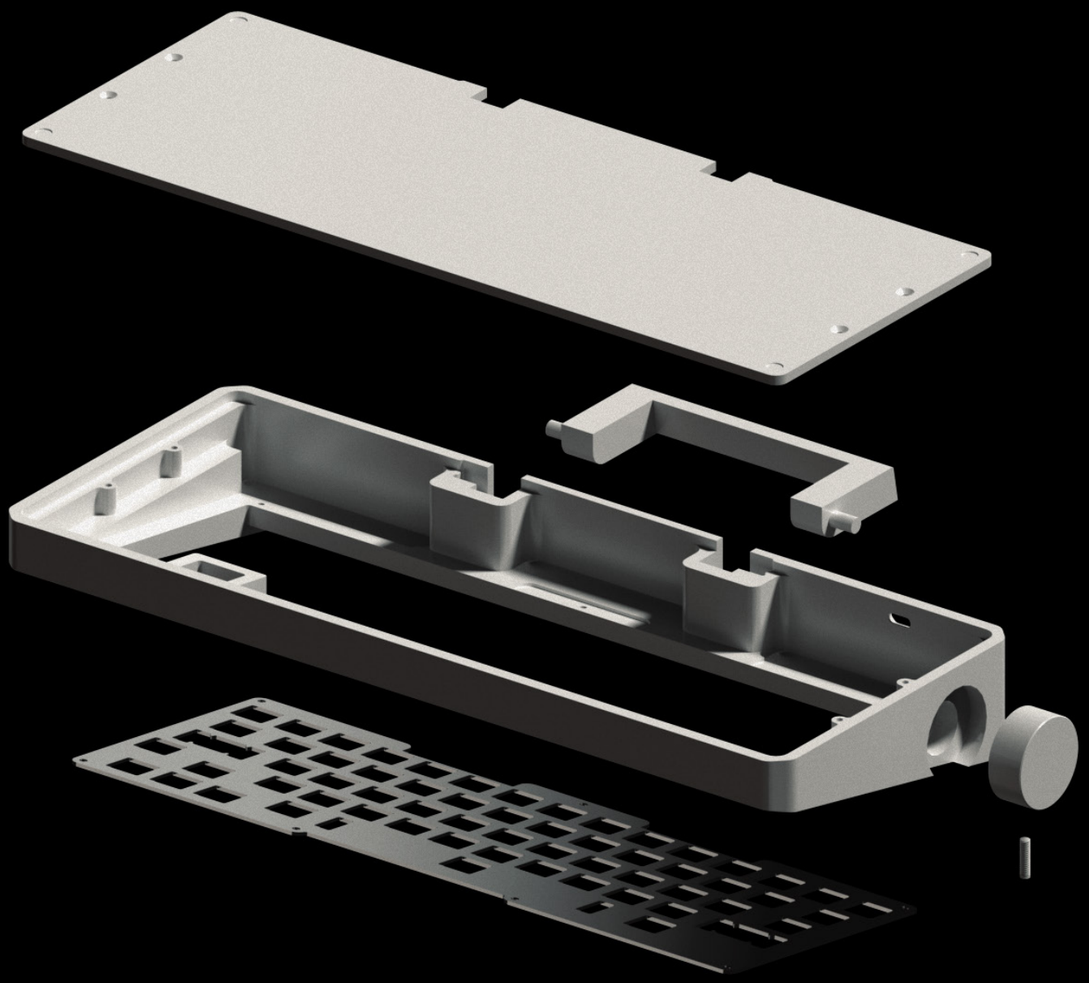
# MATERIAL SELECTION

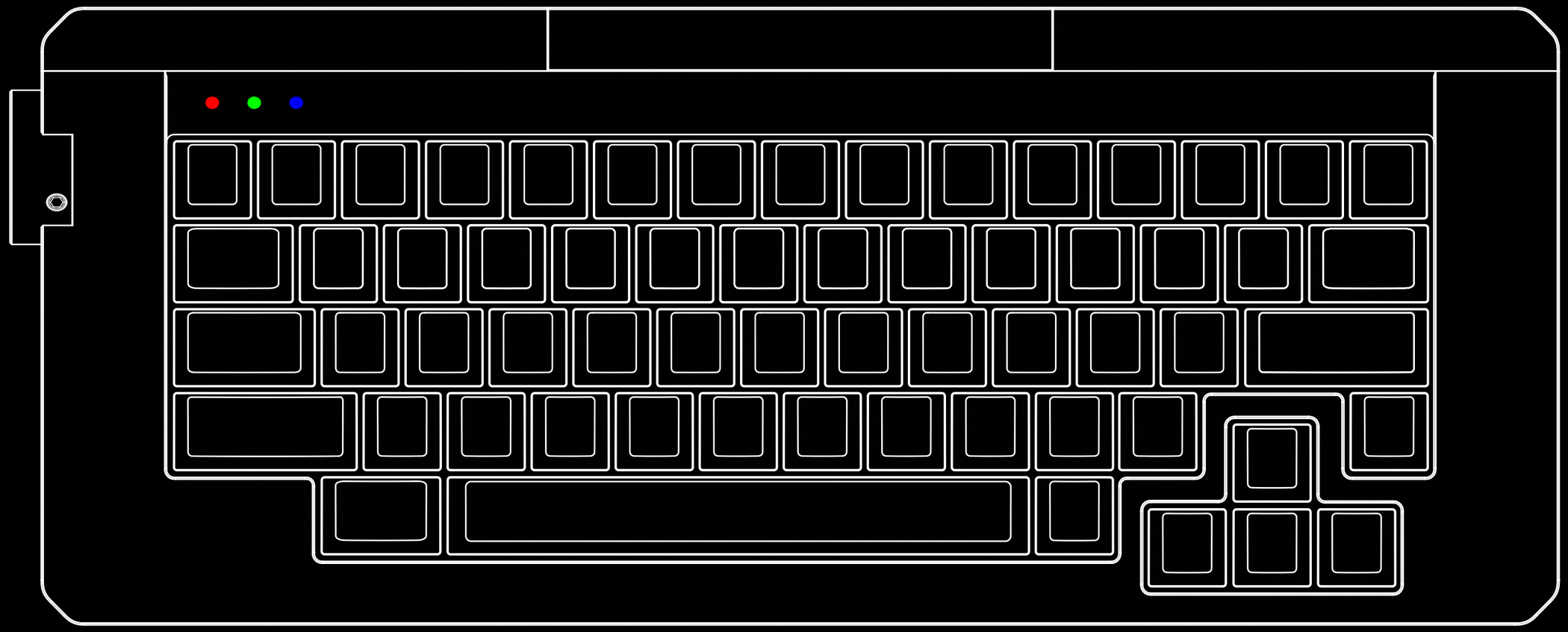
This stage just before being sent away to a manufacturer was also the time to select the exact material. I knew I wanted to use aliminum for the case and plate, which had to be anodizable. I turned out using two different variants of aluminum; 6082 for the case parts, and 5052 for the thin mounting plate. This difference came due to the different manufacturing methods; the plate staying thin and flat. The case parts were then annodized in a matte finish, while the plate was ordered in a as-machined finish.



## CNC'd PARTS

To the right of this spread are the parts as sent away for machining. The case consists of five parts; top, bottom, plate, handle and side wheel. The handle is secured between the top and bottom, which are secured by screws. With one rounded and one sharp angle, it stays secure at a 90 degree when folded out.

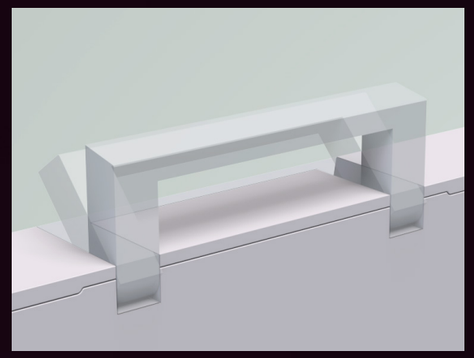




# PART 3: RESULT

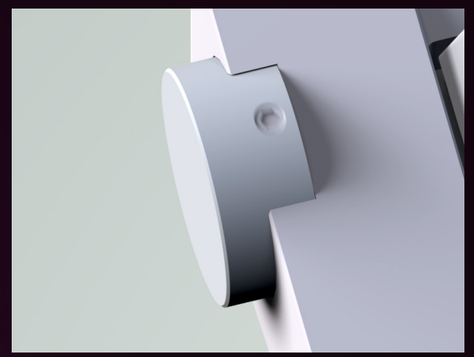

## THE FINAL BOARD

And here it is, the finished product. One of the first thing that sticks out is the **R G B** LED's, used to indicate the different keyboard modes. Other changes from the last sketches includes the chamfered edges and screw detailing on the wheel.



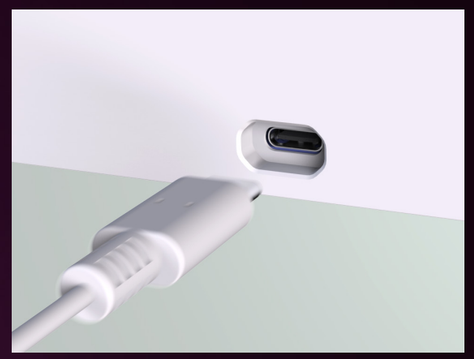
## HANDLE

The handle folds out to 90 degrees from the top of the board, giving the possibility carrying it from the top. When folded up, the handle sits at the top securely due to its flat bottom that locks it shut against whatever material it is placed on.



## SIDE WHEEL

The side wheel sticks out on the side of the board, allowing turning both by sliding its top or gripping by its side. The screw is needed for its fastening onto the potentiometer component, but instead of being hidden, it is turned into a design detail.



## REMOVEABLE CABLE

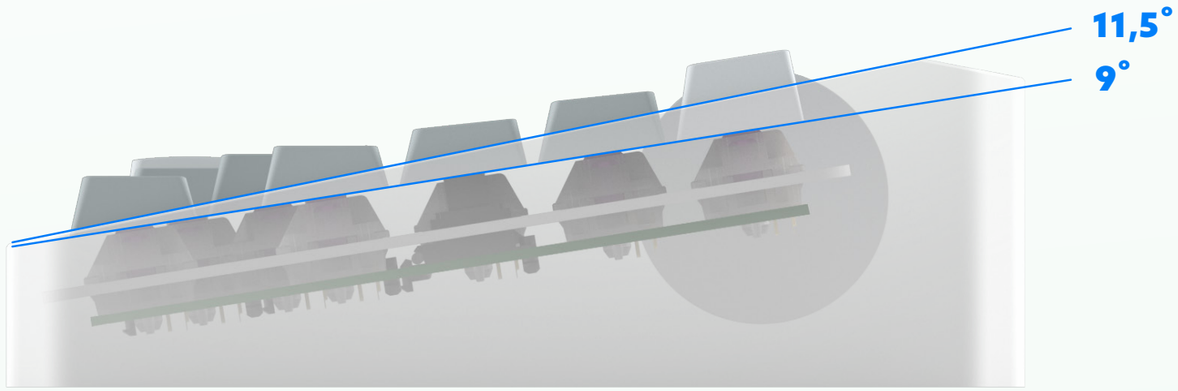
To make the board easier to move, the back USB C port allows for interchangable cables. This further makes room for further customization, giving the user the option of using custom cables in a material and color of their choice.

## INDICATOR LED'S

The RGB LED's, taken as an inpiration from the Gabriele writer's exposed lights, are used to show which of the keyboards modes are turned on and off. The three selectable modes are standard on all keyboards; Caps lock, Scroll lock and Insert.

## USER INTERACTION

In the end, all functions of the keyboard are designed with the user in mind. Through carefull consideration between form, function and the way they are mixed, the result is a product that is made to create a connection with its owner. An example of this is the inclusion and emphasis of the top handle. Allthough it might not be seen as a top priority in a keyboard from a purely functional point of view, its prior function is to create a story and a unique detail which the user can interact. After all, connecting the product to the user could arguably be seen as the primary function of all manmade objects.




## TYPING ERGONOMICS

As discussed in the introduction of this report, the board has been designed to comply with ISO standardization regarding typing ergonomics. Using a method found in the Gabriele typewriter, the boards case sits at an angle of 11,5 degrees, while the slant of the actual keycaps sits at 9 degrees. The angle can also be slightly altered by the use of differently pertruded rubber bumpers on the bottom.



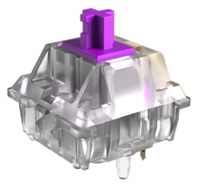
## THE INPUT WHEEL

The side wheel of the keyboard is entirely programmable by its user, with a wide variety of features available. Some examples include volume adjustments, website scrolling, and adjusting colors or other sliders in supported programs. The wheel is easily turned, with a slight clicking haptic feedback during its rotation.

CHERRY BLUE

CHERRY RED

GATERON GREEN



ZEELIO

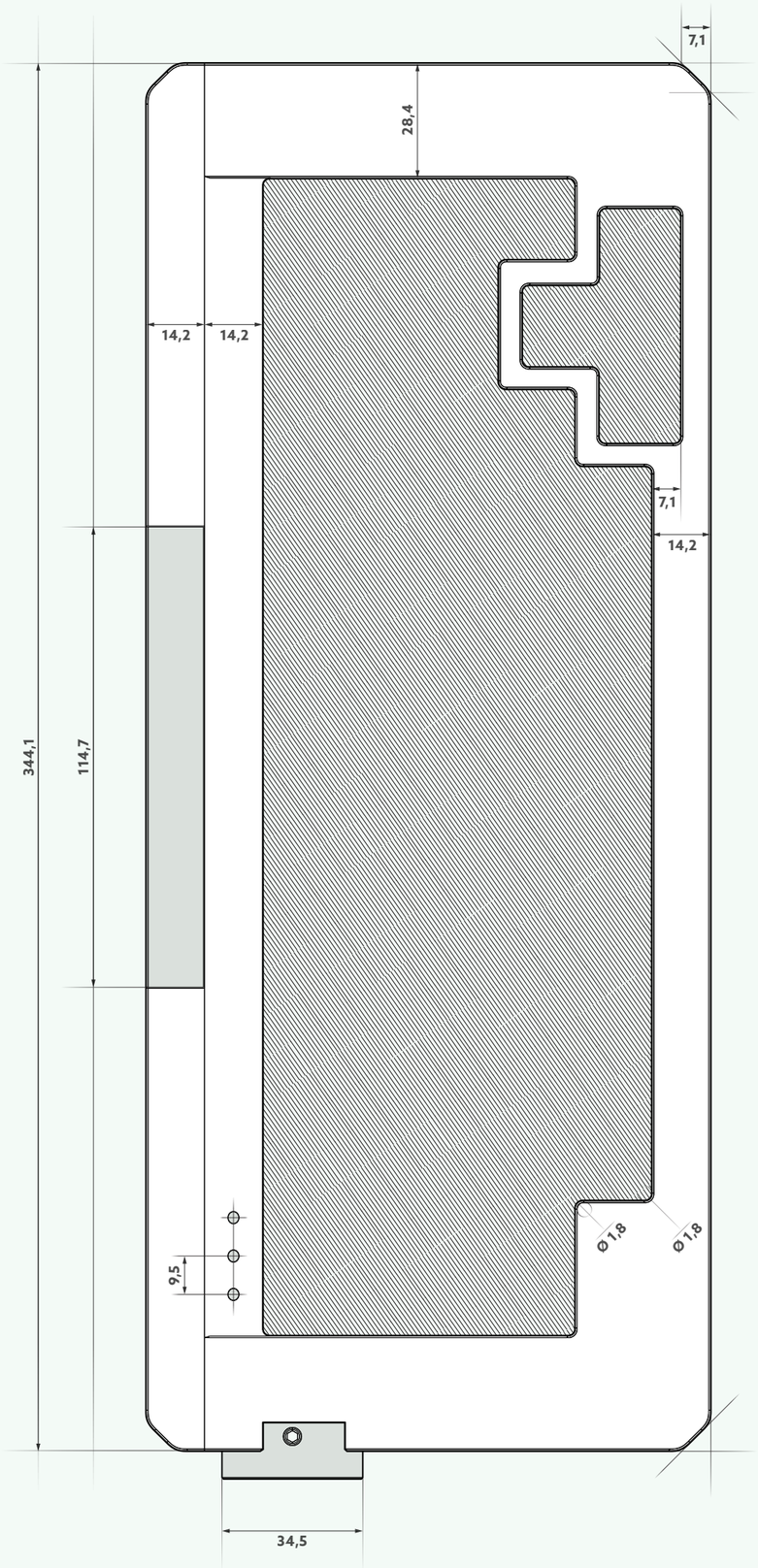
HEALIO V2

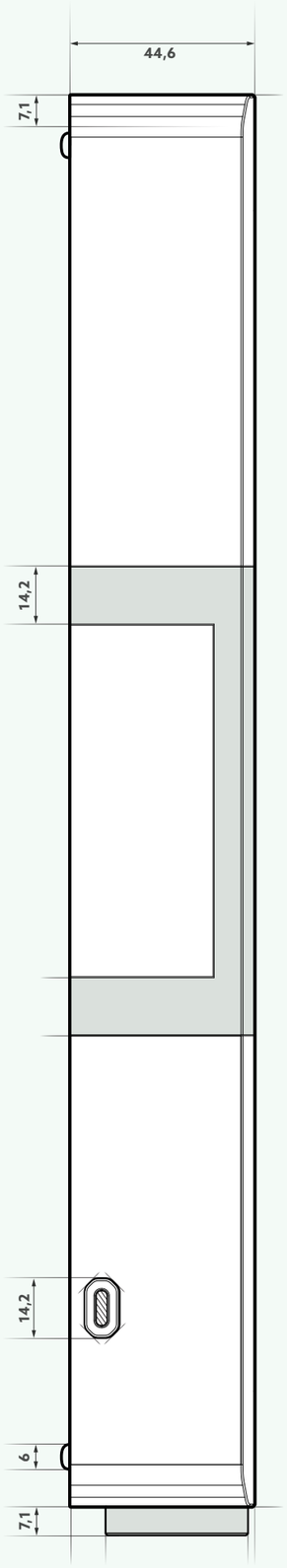
# CUSTOMIZABILITY

Shown above is a few variants that would be possible to produce. While the case variant in the bottom right corner is the standard variation shown throughout this project, it is important to mention that the parts are produced in such a way that recolors or special editions would be possible to produce. But, as previously stated, the main point of customizability comes from the keycaps and keyswitches.

The switch is what gives the keyboard its feel and weight. Available in many variants, they range from smooth and linear, to heavy and clicky, and there are a huge range of custom switches to choose from on the market - each tailored to the users preferences. Changing the switch can easily be done by resoldering them on the PCB, due to the use of large mounting holes for ease of access.



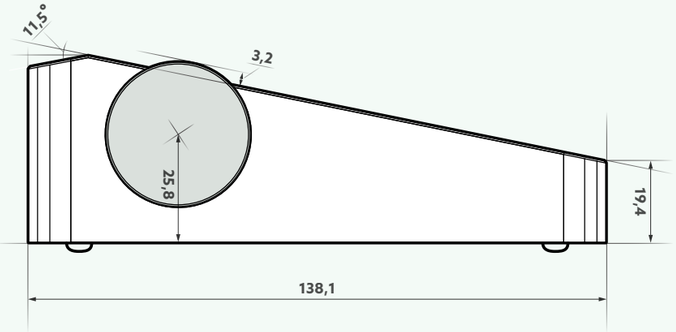



# TECHNICAL DRAWING

It is not until being shown on a technical drawing that much of the detail work of the final board is shown. Every angle, chamfer and radius has been under scrutiny, in order to achieve the prefered look and feel of the product.

**7,1** is a measurement that is recurring in many parts of the board. The importance of this number comes from the distance between the bottom row, and the bottom of the arrow cluster; the only measurement that can not be changed. Thus, to keep the distances uniform, the entire board was designed based on a grid of this size.

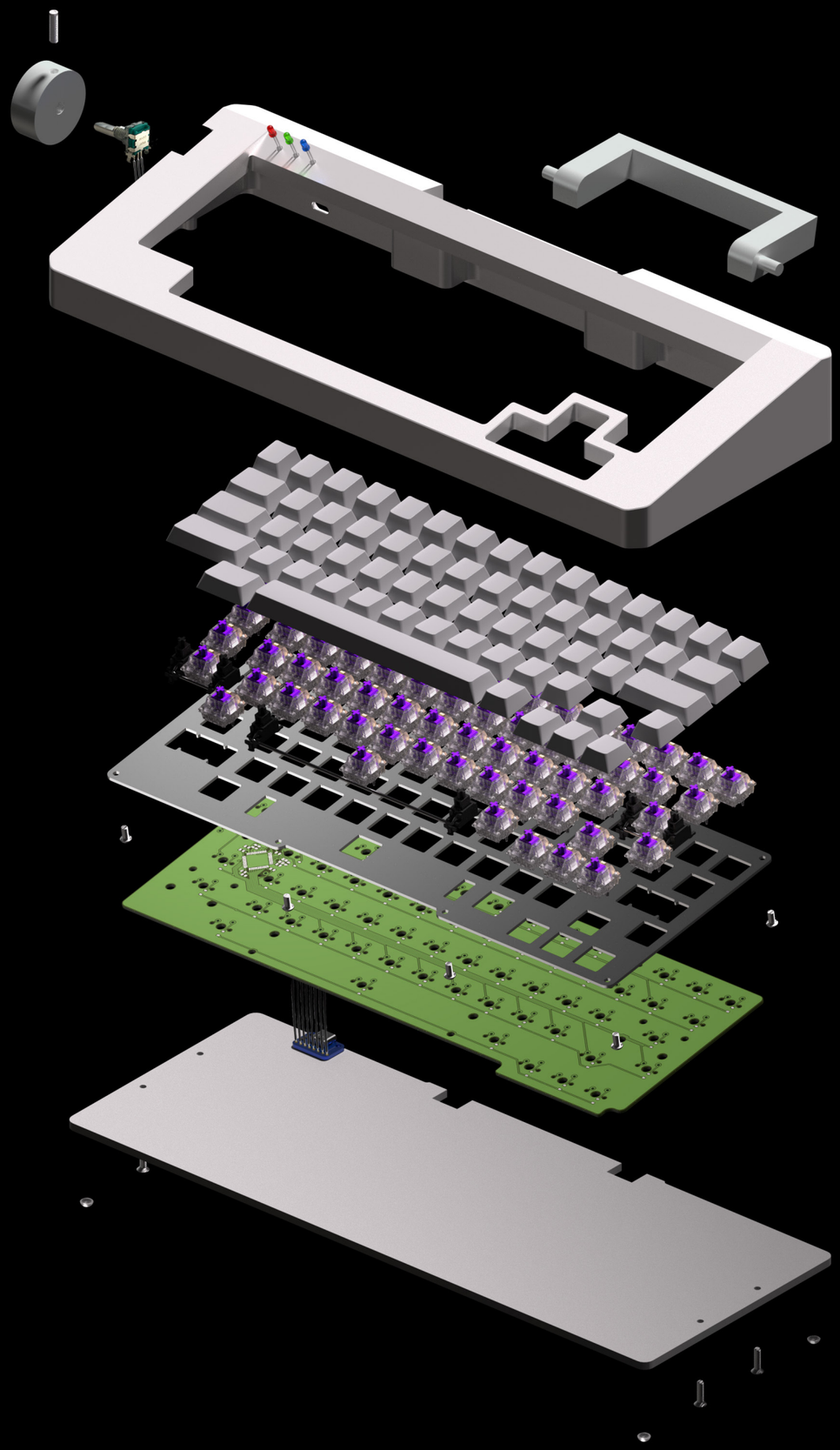


# PART ASSEMBLY

The case parts are secured together with the use of screws, encasing the inner components. The indicator LED's as well as the side mounted potentiometer is soldered to the PCB board, to the nearby seated connector pins. Securely seated towards the side, the potentiometer is pushed through the hole and secured in place from the outside of the board, and the LED's are slid into place from the inside.

# DESIGNED FOR DISASSEMBLY

While the keyboard is primarily made to be used in its assembled state, much effort has been placed in order to make for a smooth separation of the parts. Using no glue or permanent solutions for joining the parts together, the board is truly designed for disassembly.



# ORDERING FROM MANUFACTURER

Due to the Covid situation spanning the entire duration of this project, producing the final prototype at LTH campus was not a viable option. Instead, the prototype had to be outsourced.

This turned out to be a very valuable experience, working with files to hand to the producer, as well as learning from the issues and questions that arrose as production began. During this stage, revisions had to be made to the final 3D model in order to comply with the factorys tools, resulting in a result that was easier to make, and turned out cheaper than the first estimates.

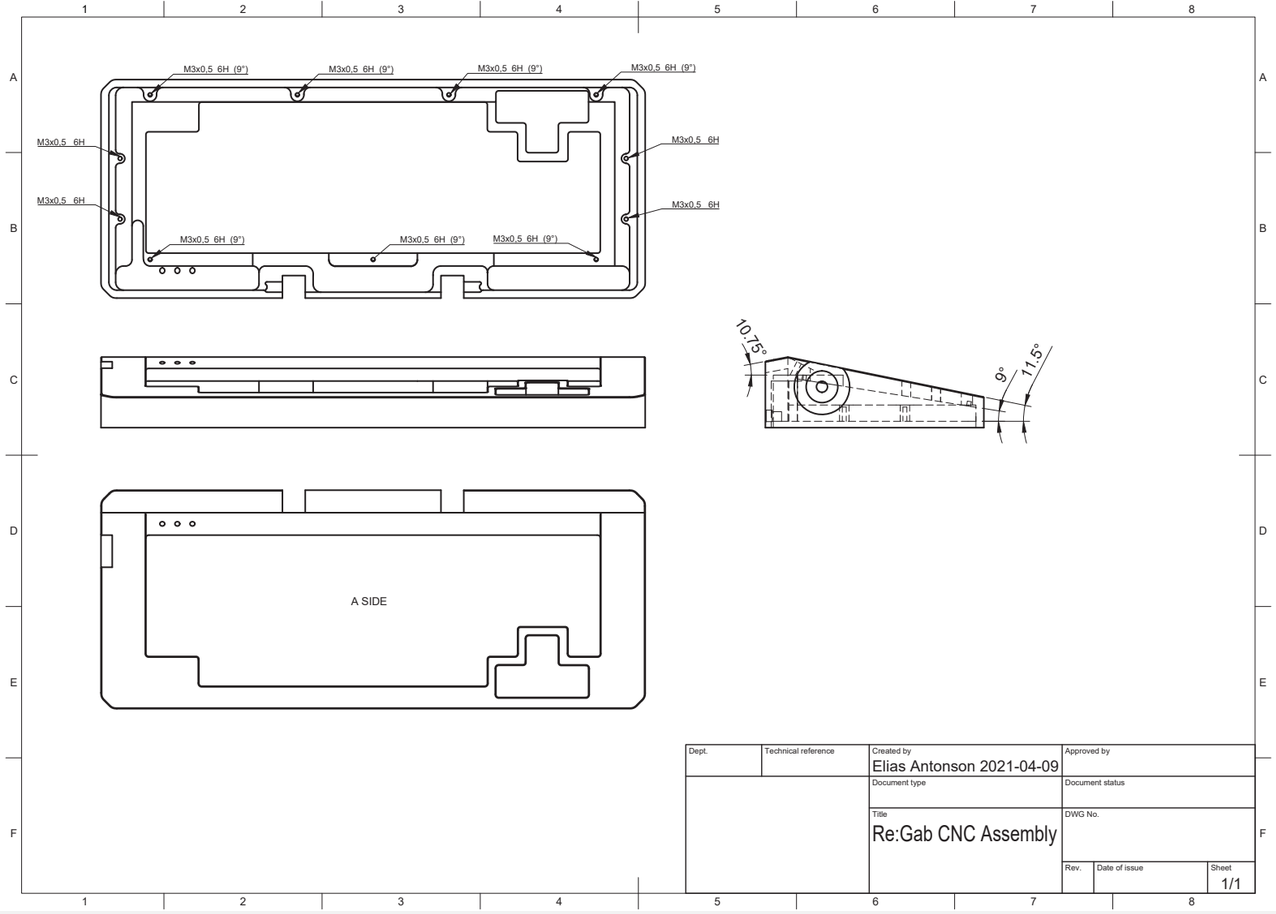
After a long wait, the parts were managed to be produced just in time, and the final prototype was possible to assemble. Finally having the physical prototype in hand made for many ideas and possibilities for new solutions that otherwise would have not been made possible.

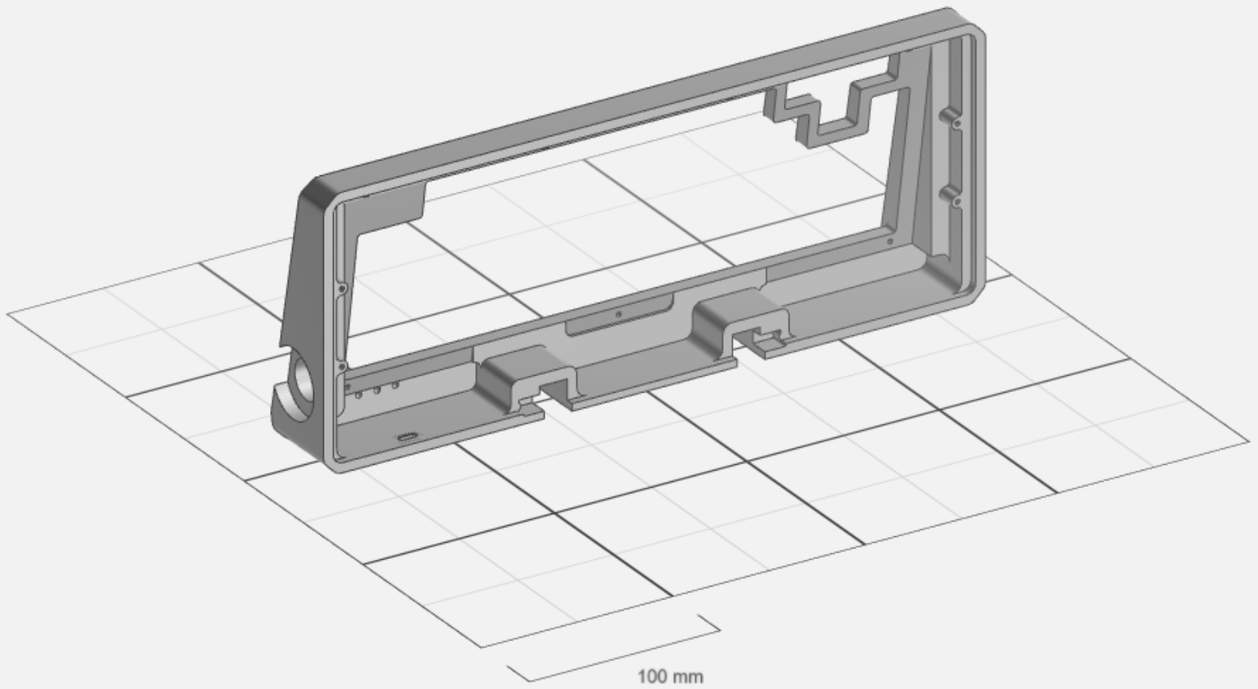
A big thanks to the people over at HUBS, my chosen manufacturer, for the help and directions regarding the manufacturing of this project.

HUBS

A PROTOLABS COMPANY





# REFLECTIONS

Looking back at the past weeks and months, it is fair to say that this project has been a huge learning experience. Most of all, it has shown me how much knowledge I have gained over the course of this education. Being the first time I have developed a product from start to finish with manufacturability in mind as the end goal, I am very proud and happy of the final result.

This project stems from a question that I have had in mind for a long time, namingly how to use the form and design from the generations before us, and place it in a modern context. Getting the oportunity to dive into this brief and come out on the other side with a final product in hand has been a huge eye opener.

With the restrictions that comes from the lack of physical work in the school workshops has made for a very interesting process, and forced me to dive deeper into some areas that would otherwise not be as critical. Thus, if the circulmstances were not the same, I am unsure if I would have learned what I have learned, and if the final product would look the same.


# SPECIAL THANKS TO

Project Supervisor: **Charlotte Sjödell**

Course Supervisors: **Claus-Christian Eckhardt, Anna Persson** & **Jasjit Singh**

Outside Consultant: **Kate from RAMA WORKS**

## SOURCES


[1] *Grant, T. (2003) "**International directory of company histories. Vol. 48**" p.382 Book, Detroit. (ISBN 1-55862-466-X).*

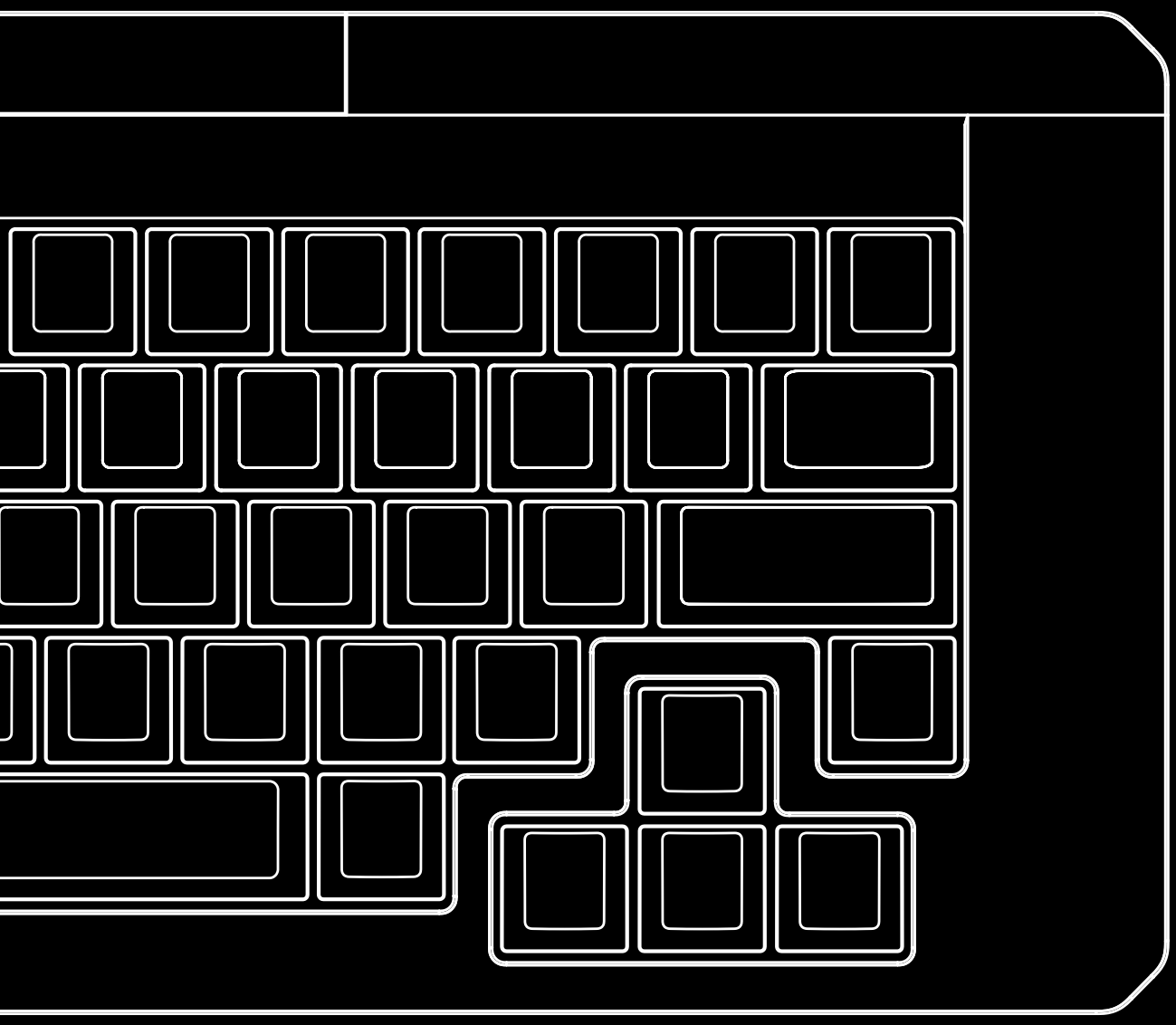
[2] *Kaddoura, M., Kambanou, M., Tillman, A., Sakao, T. (2019) "**Is Prolonging the Lifetime of Passive Durable Products a Low-Hanging Fruit of a Circular Economy?: A Multiple Case Study**" Journal article, Switzerland. (ISSN 2071-1050).*

[3] *Anastas, P.T., Zimmerman, J.B. (2003) "**Design Through the 12 Principles of Green Engineering**" Publication, Nottingham. (ISSN 1937-4178).*

[4] *www.iso.org/standard/38899.html*


## PICTURES


*Chandler Bondurant (2020) "**How to Buy a Mechanical Keyboard**", Gear Patrol www.gearpatrol.com/tech/a611997/how-to-buy-your-first-mechanical-keyboard/*



# Re:Gabriele

**Elias Antonson**

**2021**

LUND
UNIVERSITY