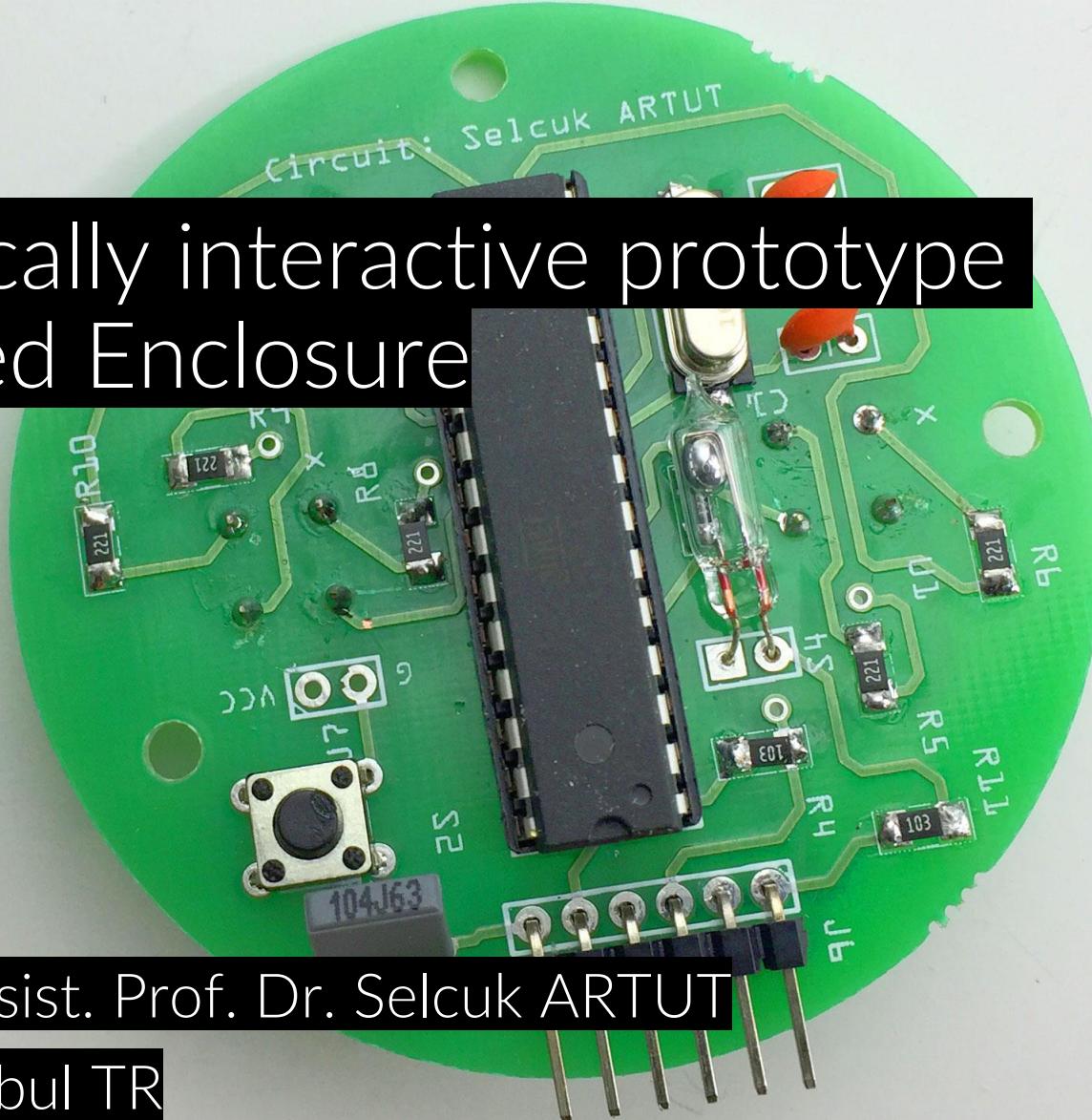




Building a physically interactive prototype with a 3D Printed Enclosure



Workshop Presenter: Assist. Prof. Dr. Selcuk ARTUT
Sabancı University, Istanbul TR

.Brief Information about the Presenter

<http://selcukartut.com>

- Faculty Member at Sabancı University, Istanbul
Program Coordinator - Visual Arts and Visual Communication Design
- Musician – member of an post-rock band Replikas + Live Coding Duo RAW
- Interaction Designer – founder of an interactive experience company Filika
- Artist – represented by Zilberman Gallery

Sabancı University, Istanbul

Visual Arts and Visual Communication Design Programme
<http://vacd.sabanciuniv.edu/>

Teaching Courses

- VA345 Creative Coding
- VA335 Sound and Image
- VA455 Physical Computing
- VA444 Interaction Design
- VA336 Interactive Sound

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adidas Originals



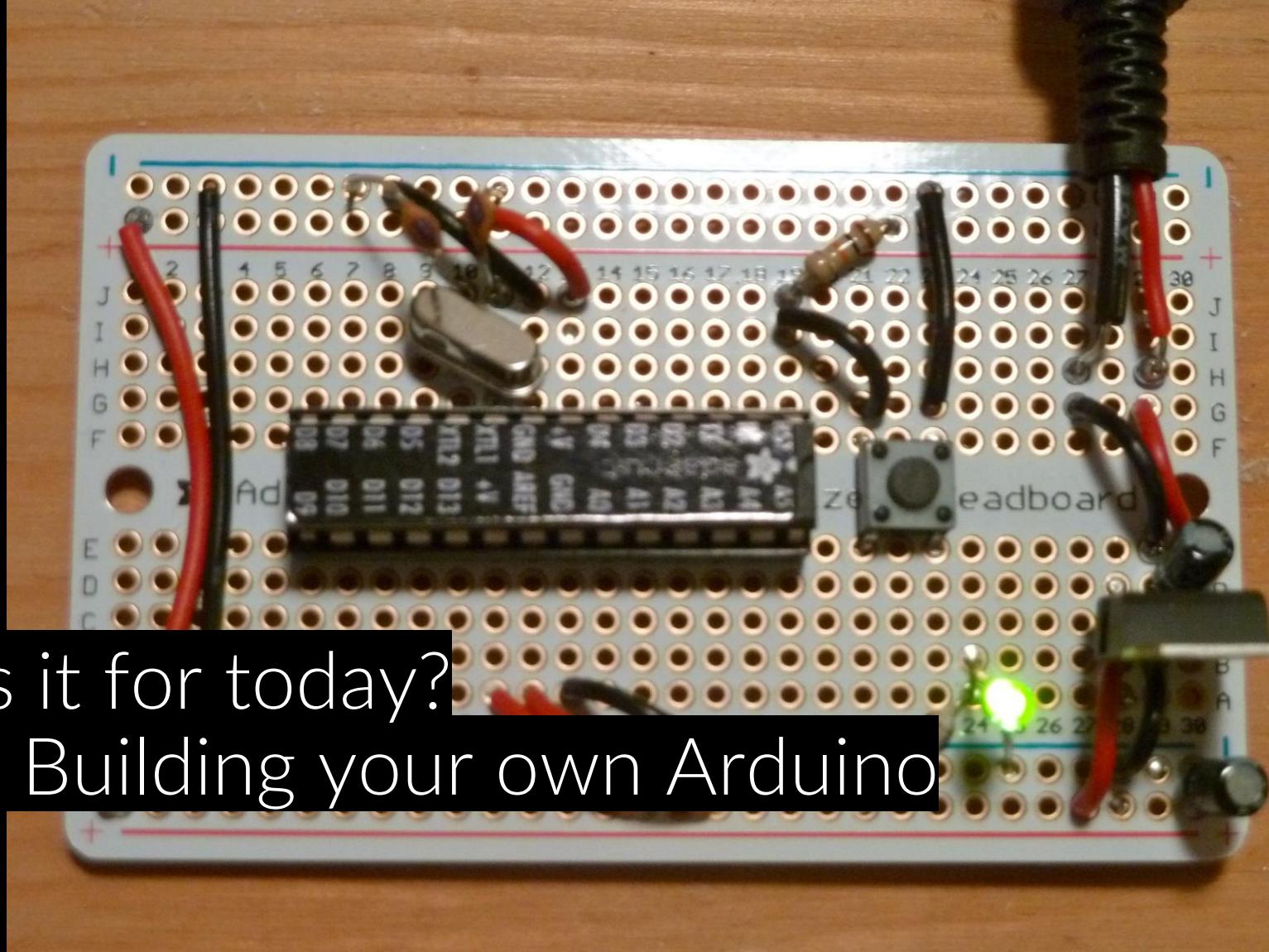
<http://www.creativeapplications.net/processing/variable-the-signification-of-terms-in-artists-statements/>

Workshop Plan

Part 1 : Building your own Arduino

Part 2 : Building an Arduino Based Circuitry Design

Part 3 : Accurate Prototyping – Designing an
Enclosure, Assembling Pieces Together



What is it for today?
Part 1 : Building your own Arduino

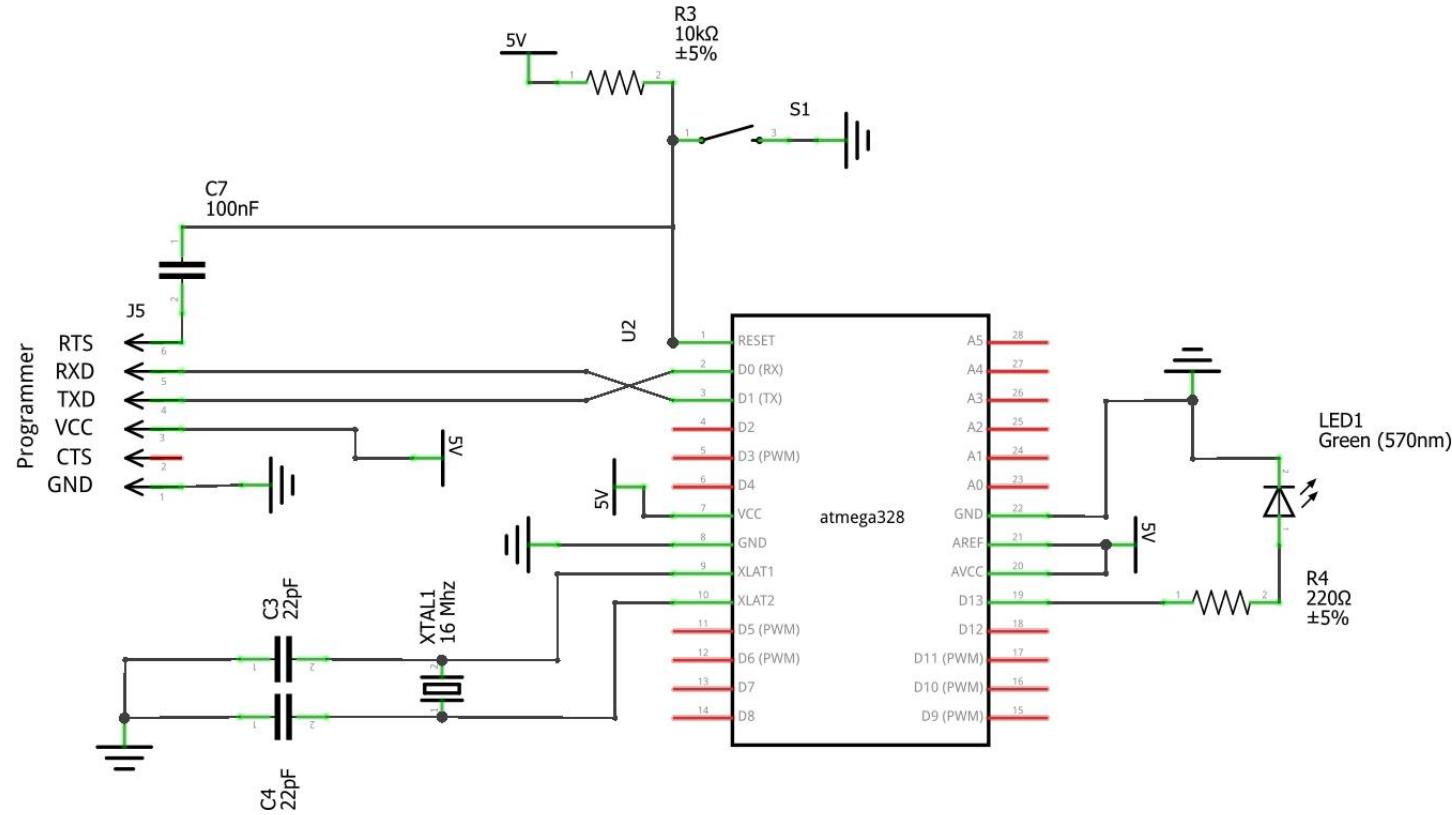
Bootloading an ATMEGA328

Recommended : https://github.com/nickgammon/arduino_sketches

- MISO to MISO
- MOSI to MOSI
- SCK to SCK
- Vcc to Vcc
- Gnd to Gnd
- Reset on target board to D10 on programming board



Building your own standalone arduino



Blink.fzz [READ-ONLY] – Fritzing – [Breadboard View]

Welcome Breadboard Schematic PCB

Parts

Core Parts

CORE Basic MINE Input PA CON TRIB Inspector

Arduino1 v. 5

Arduino Uno (Rev3)

Placement

location 2.410 0.000

rotation 0.0

Locked

Properties

family microcontroller board (arduino)

type Arduino UNO (Rev3)

part #

Tags

rev3, uno, arduino, atmega328

Connections

conn.

0 of 2 nets routed - 2 connections still to be routed

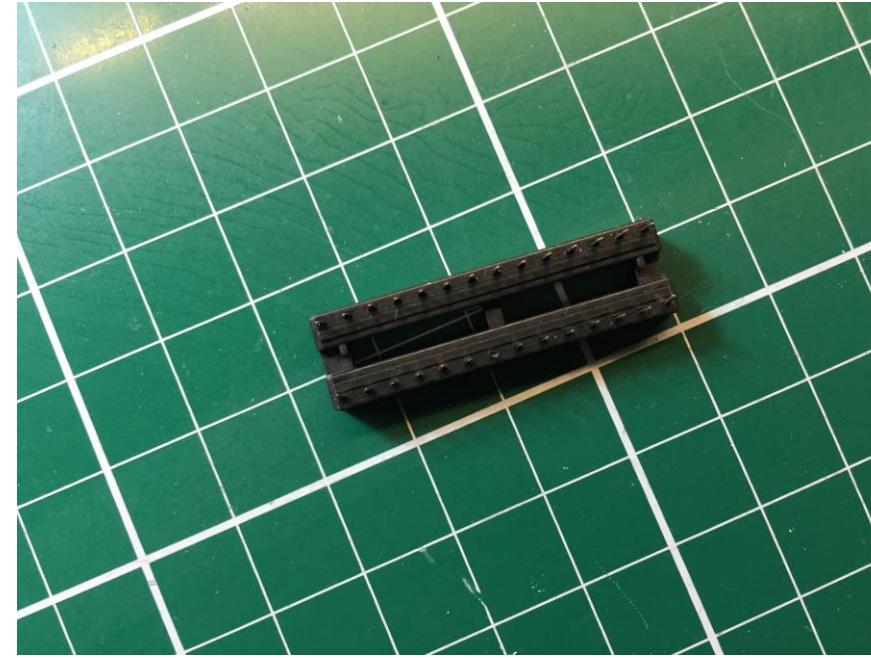
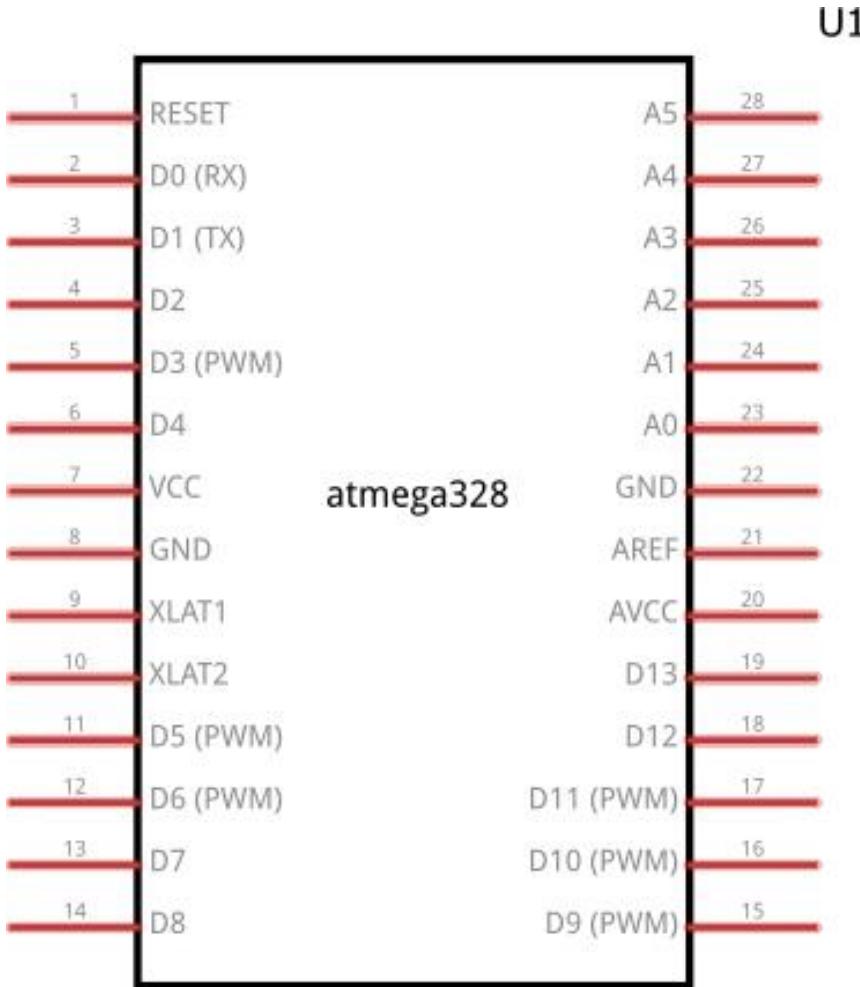
Add a note Rotate Flip Share

5.736 1.138 in 198 %

The screenshot shows the Fritzing software interface in Breadboard mode. On the left, there's a blue Arduino Uno Rev3 board with various pins and components. A red LED is connected from digital pin 13 to ground. The Fritzing logo is in the bottom-left corner. The top menu bar includes Welcome, Breadboard (selected), Schematic, and PCB. The right side features a Parts library with categories like Core Parts, Basic, MINE, Input, PA, CON TRIB, and an Inspector panel for the selected Arduino1 component. The bottom has toolbars for notes, rotation, flip, and share, along with status information about the routing progress.

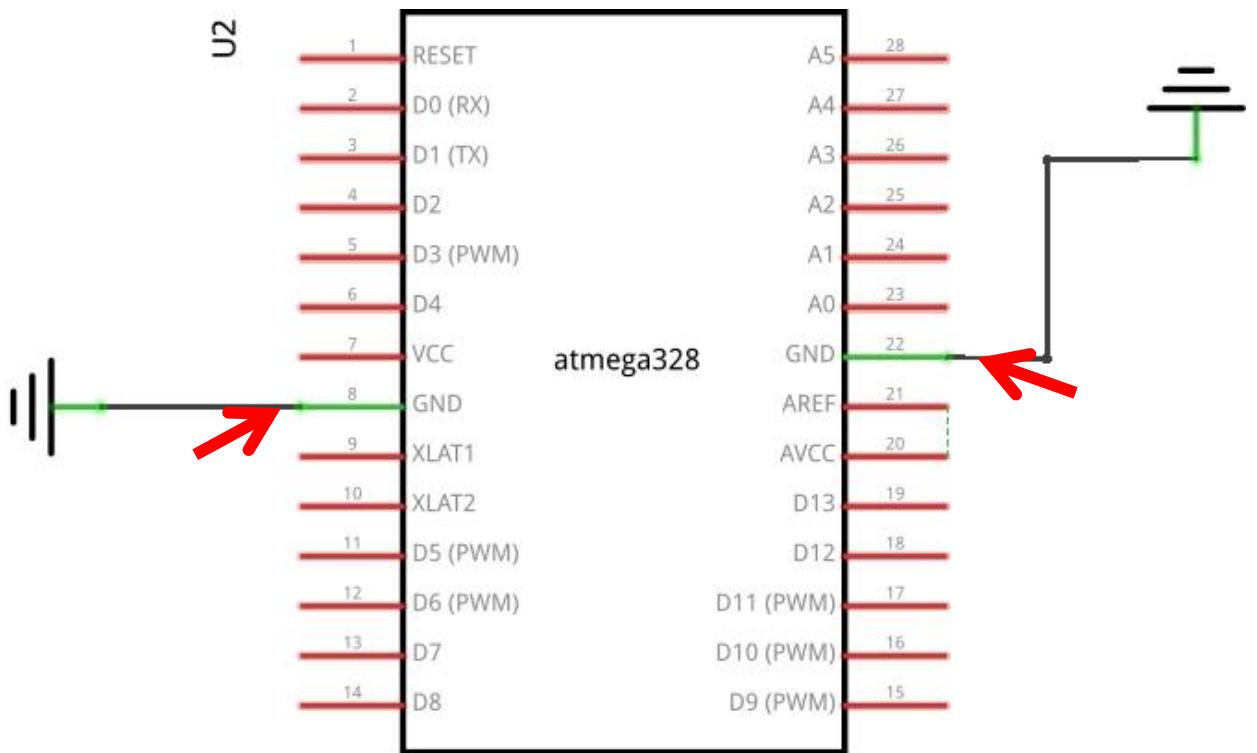
Building your own standalone arduino

Step 1 – Place your ATMEGA328 IC

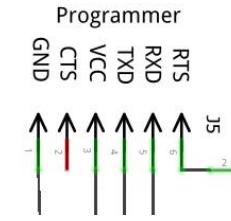
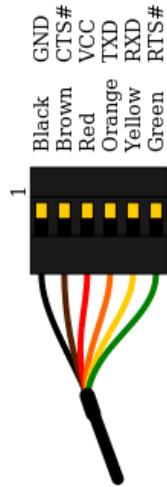


Building your own standalone arduino

Step 2 - Wire Ground Connections for IC

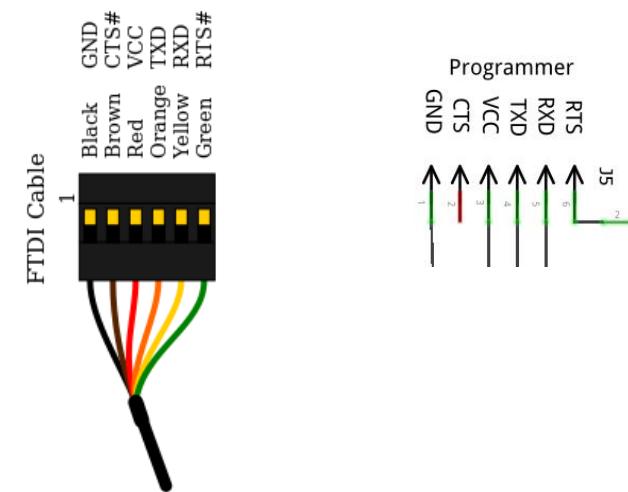
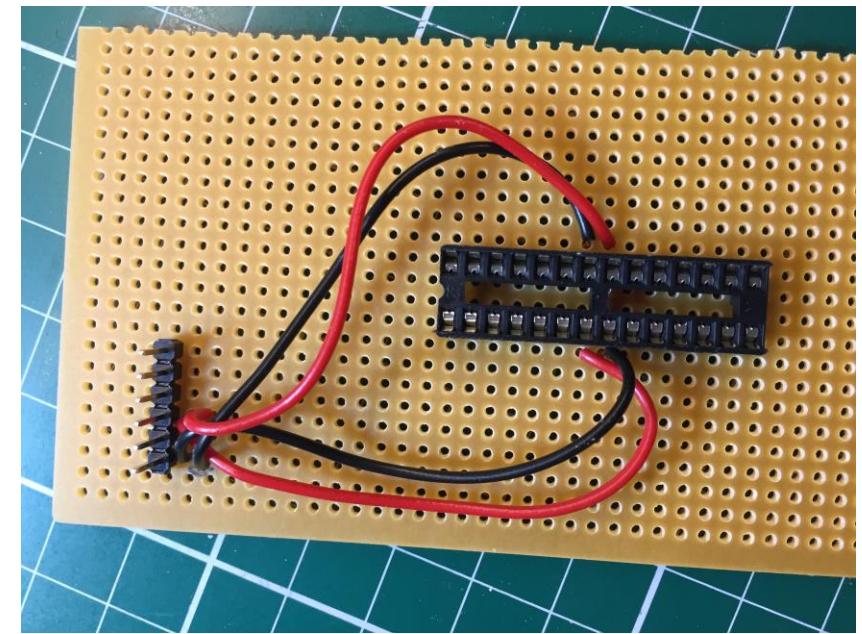
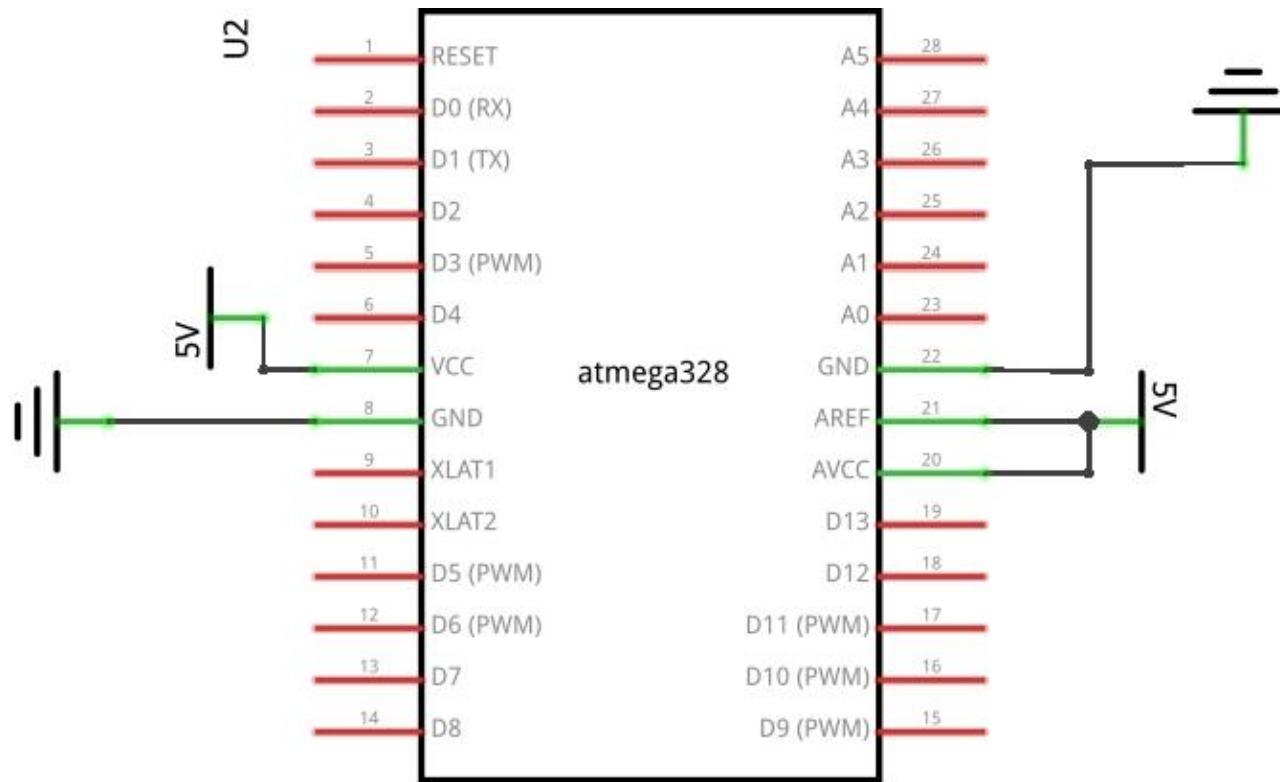


FTDI Cable



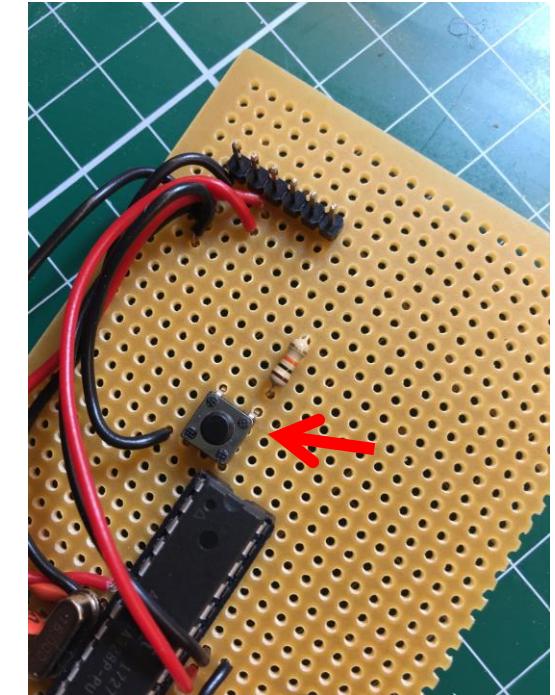
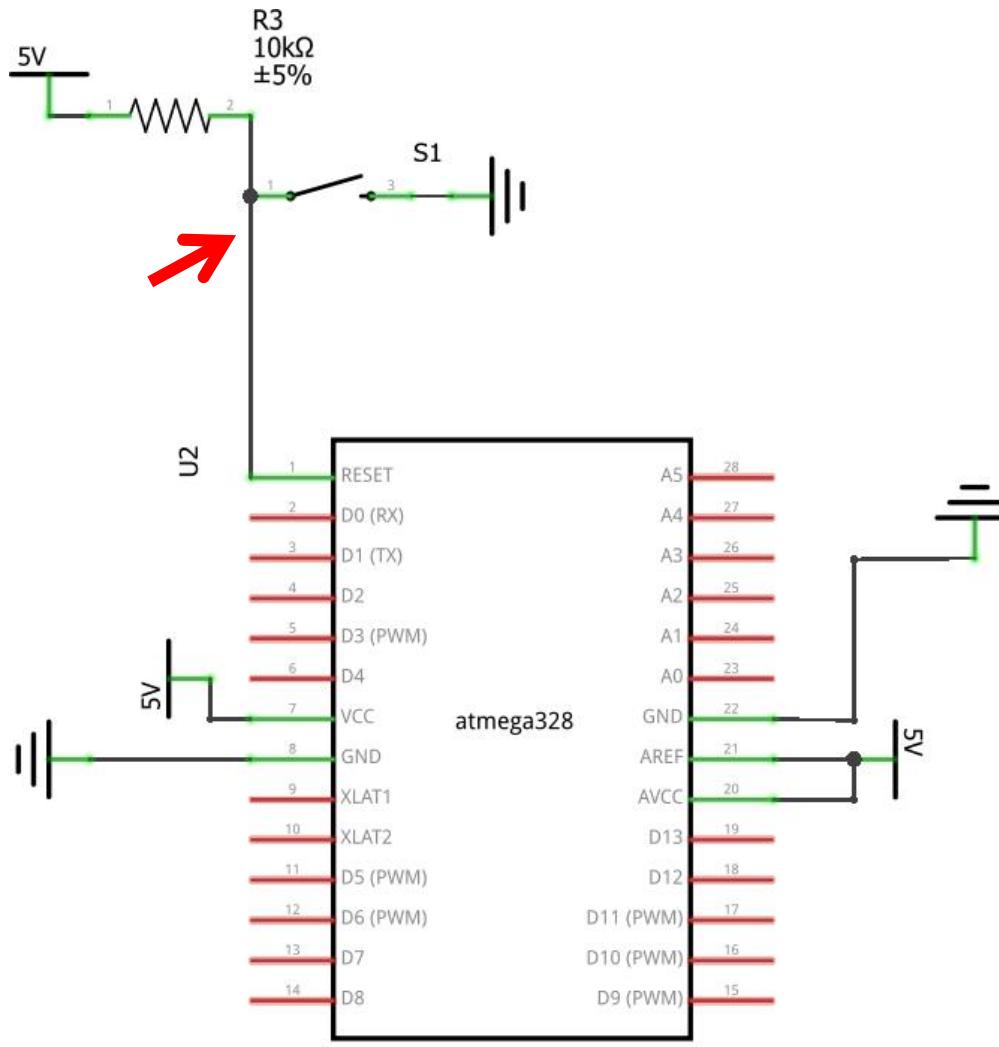
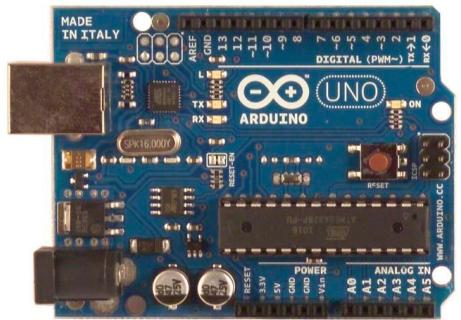
Building your own standalone arduino

Step 3 - Wire VCC (5v) Connections for IC



Building your own standalone arduino

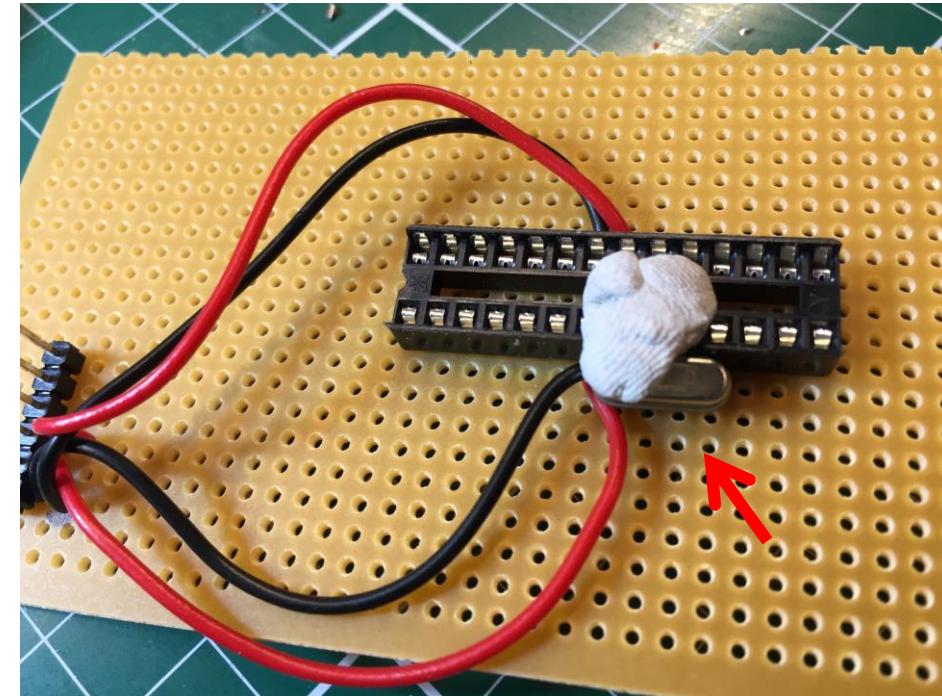
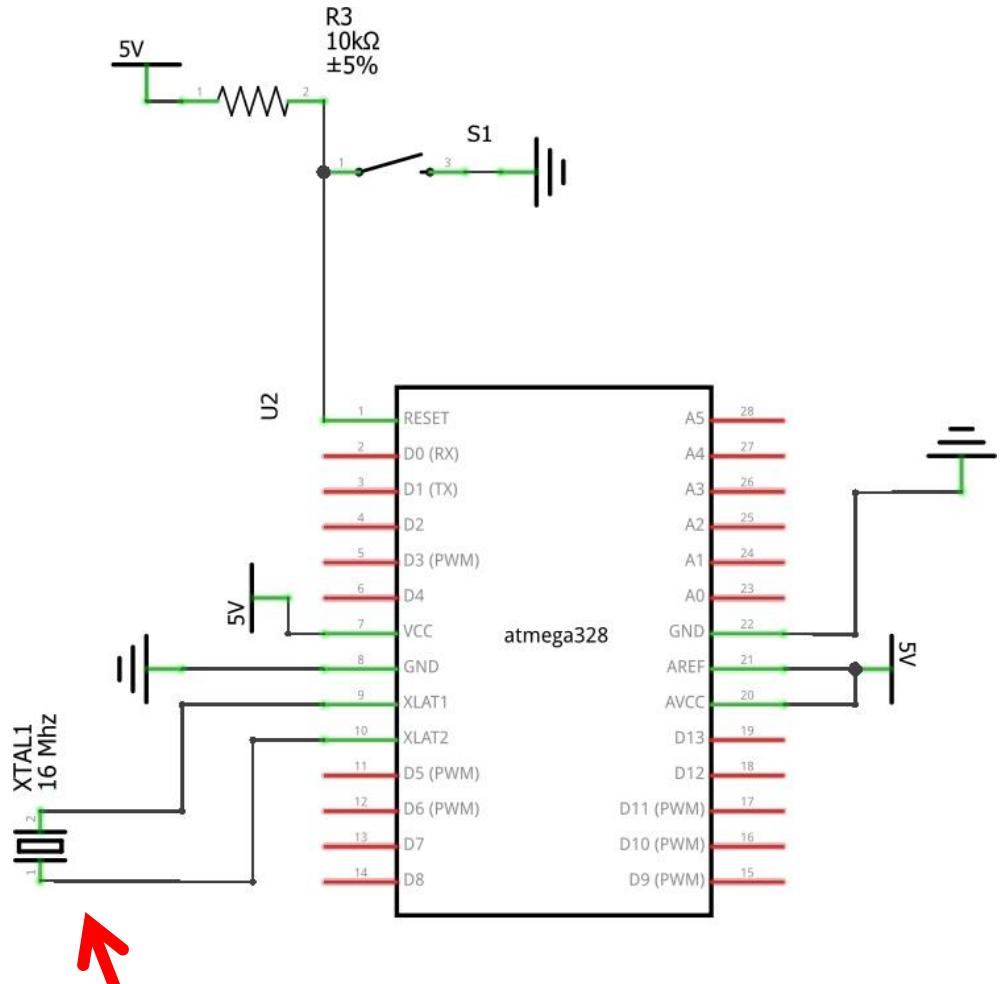
Step 4 - Reset Pin



Building your own standalone arduino

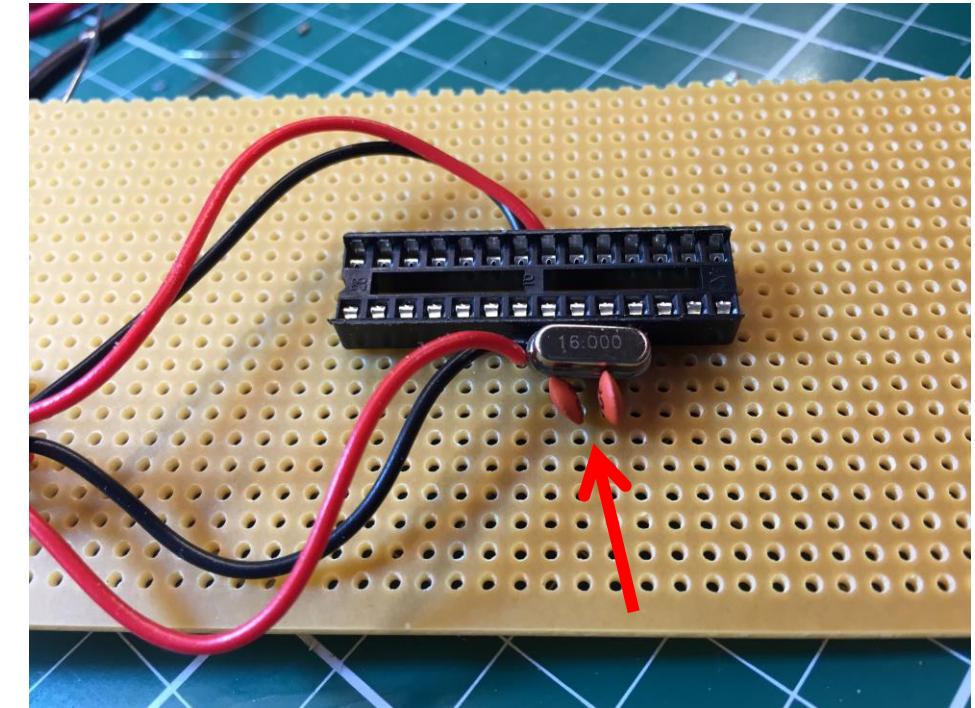
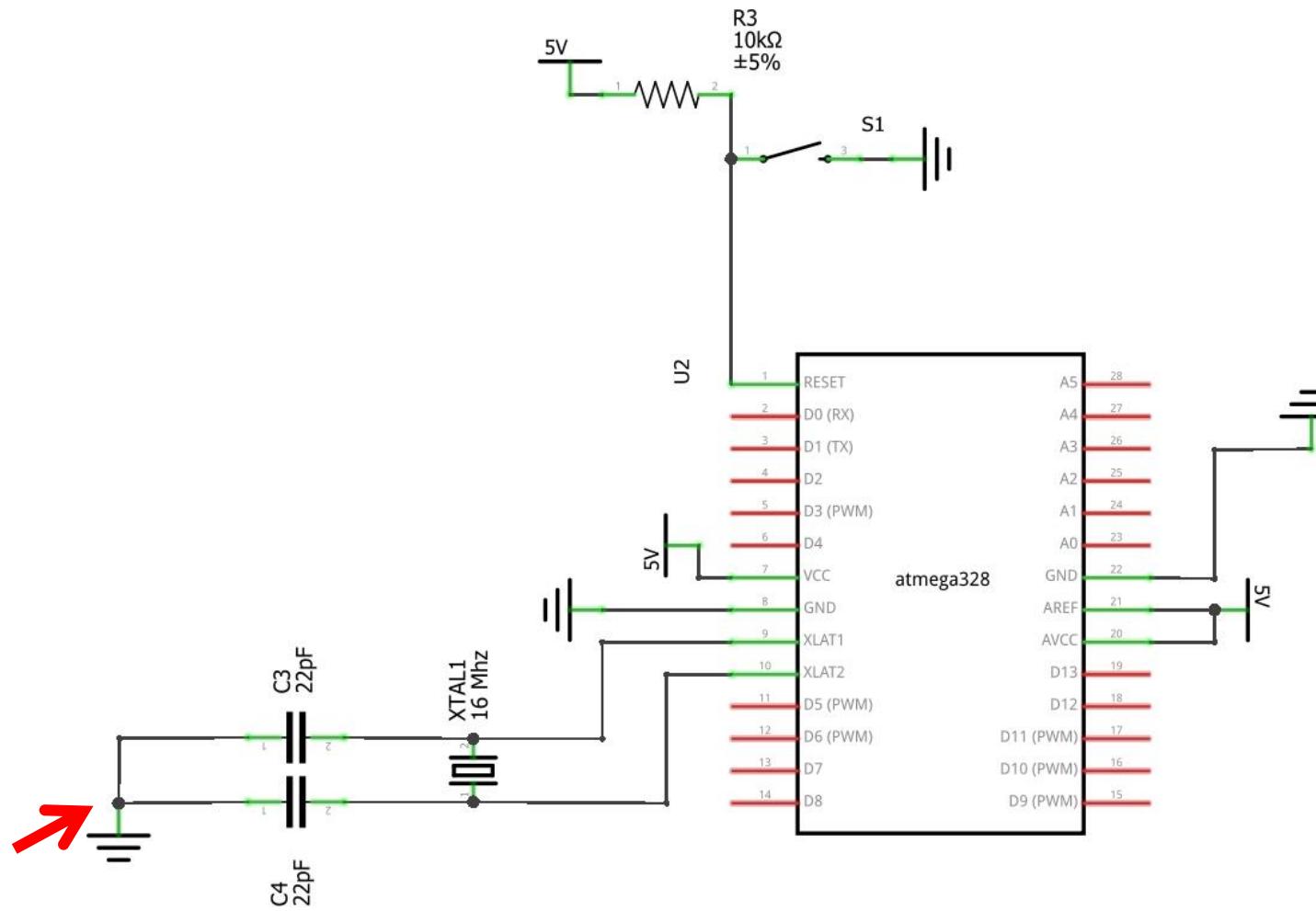
Step 5 - Add 16 Mhz Crystal between XLAT1 & XLAT2

There is no polarity



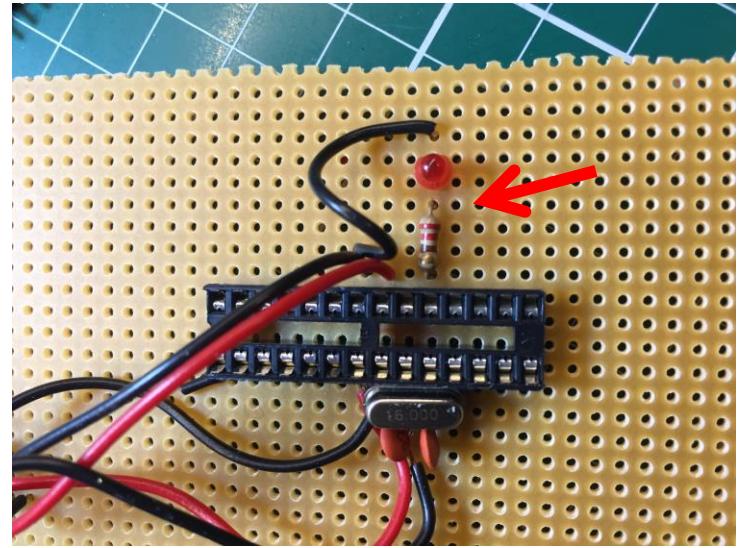
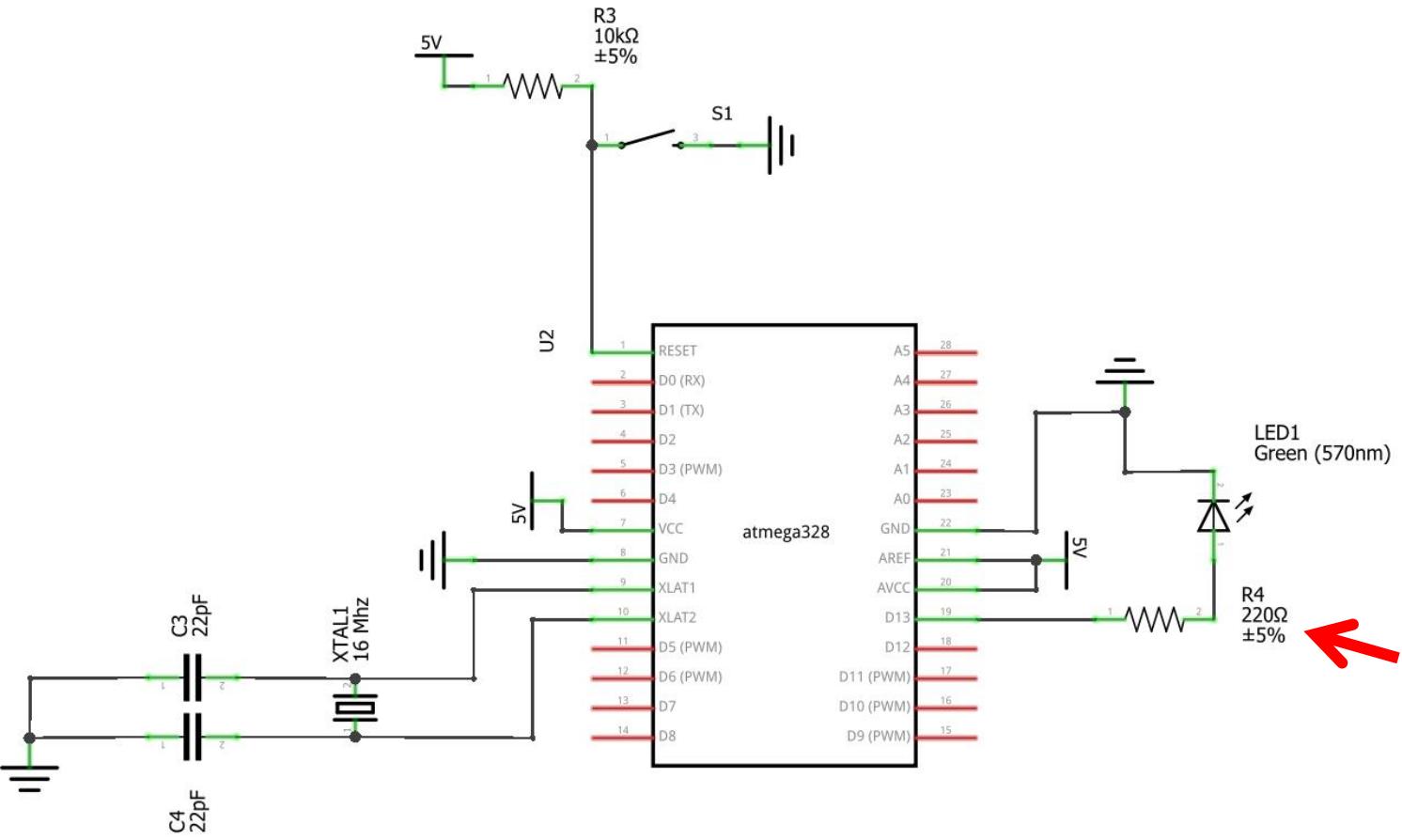
Building your own standalone arduino

Step 6 - Add capacitors to the Crystal connection and Ground them



Building your own standalone arduino

Step 7 - Add debuggin LED to pin13



Building your own standalone arduino

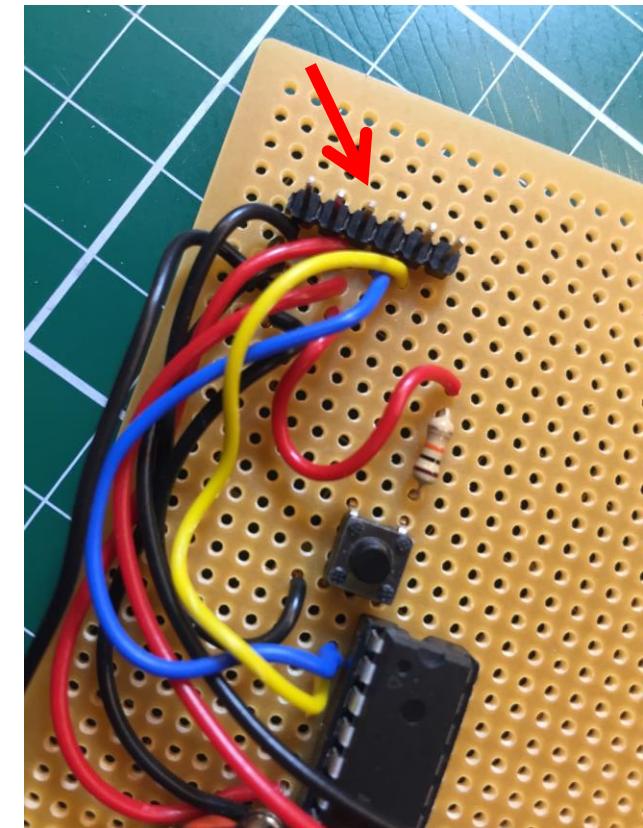
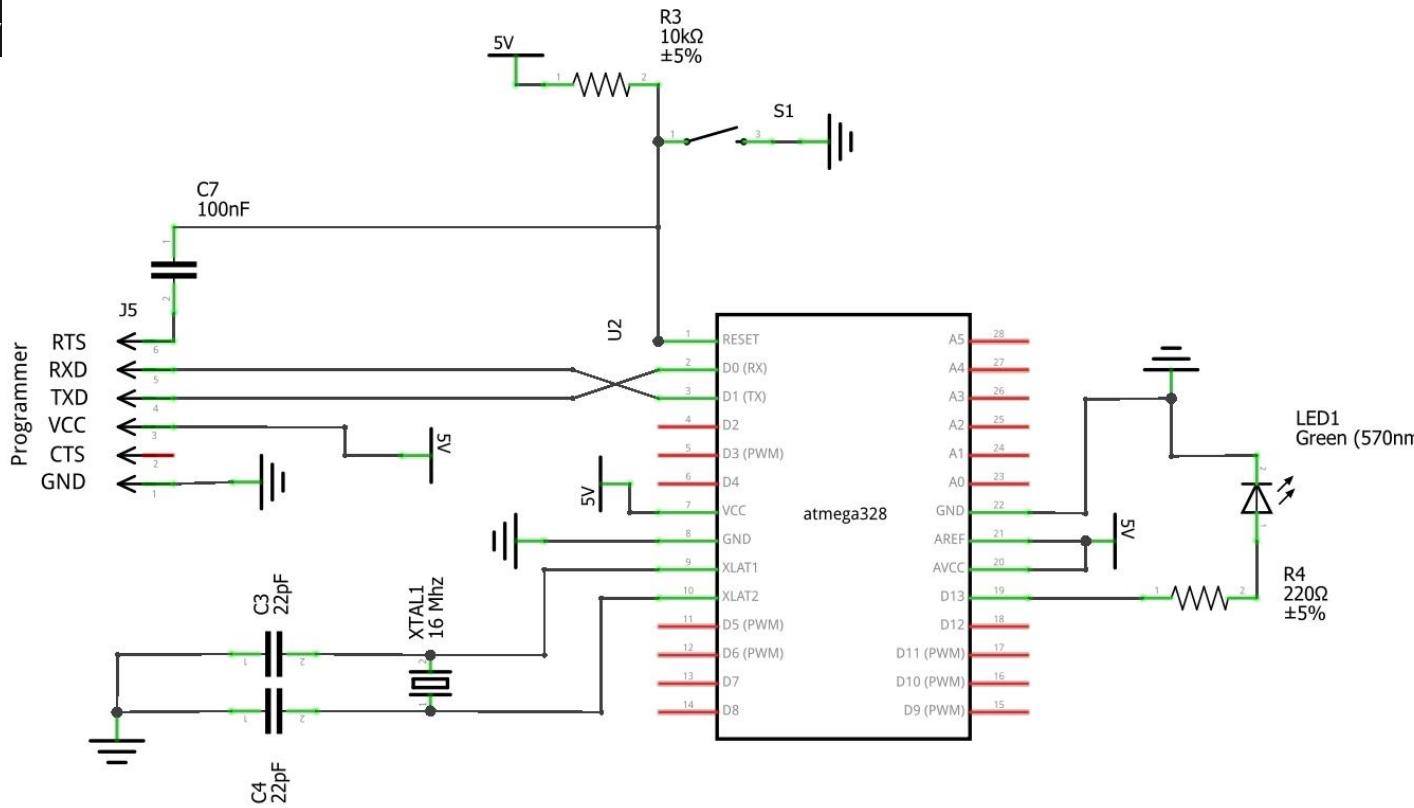
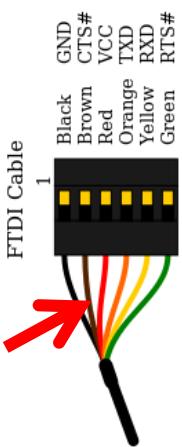
Step 8 – Prepare FTDI Programmer Connection

Connect VCC and Ground wiring for FTDI connector

Connect TX RX pins and the RTS Connection

Use a 100 nf capacitor between RTS and Pin0

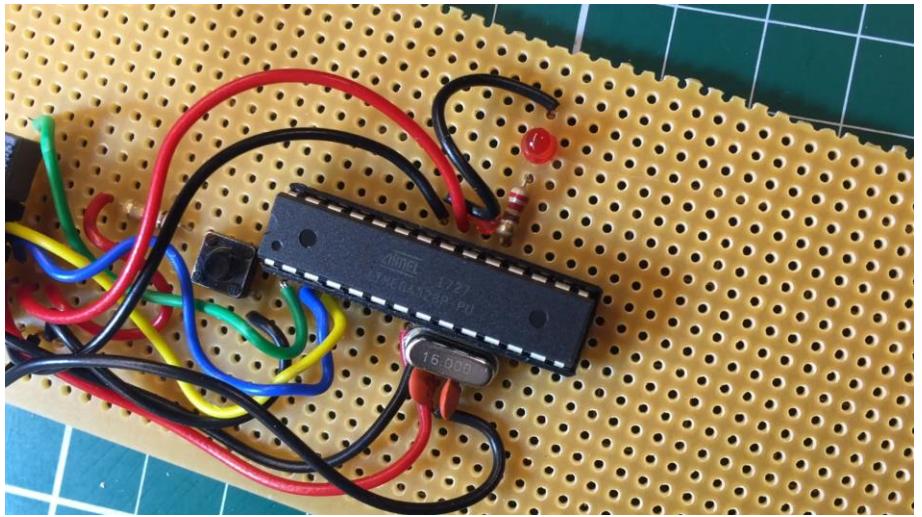
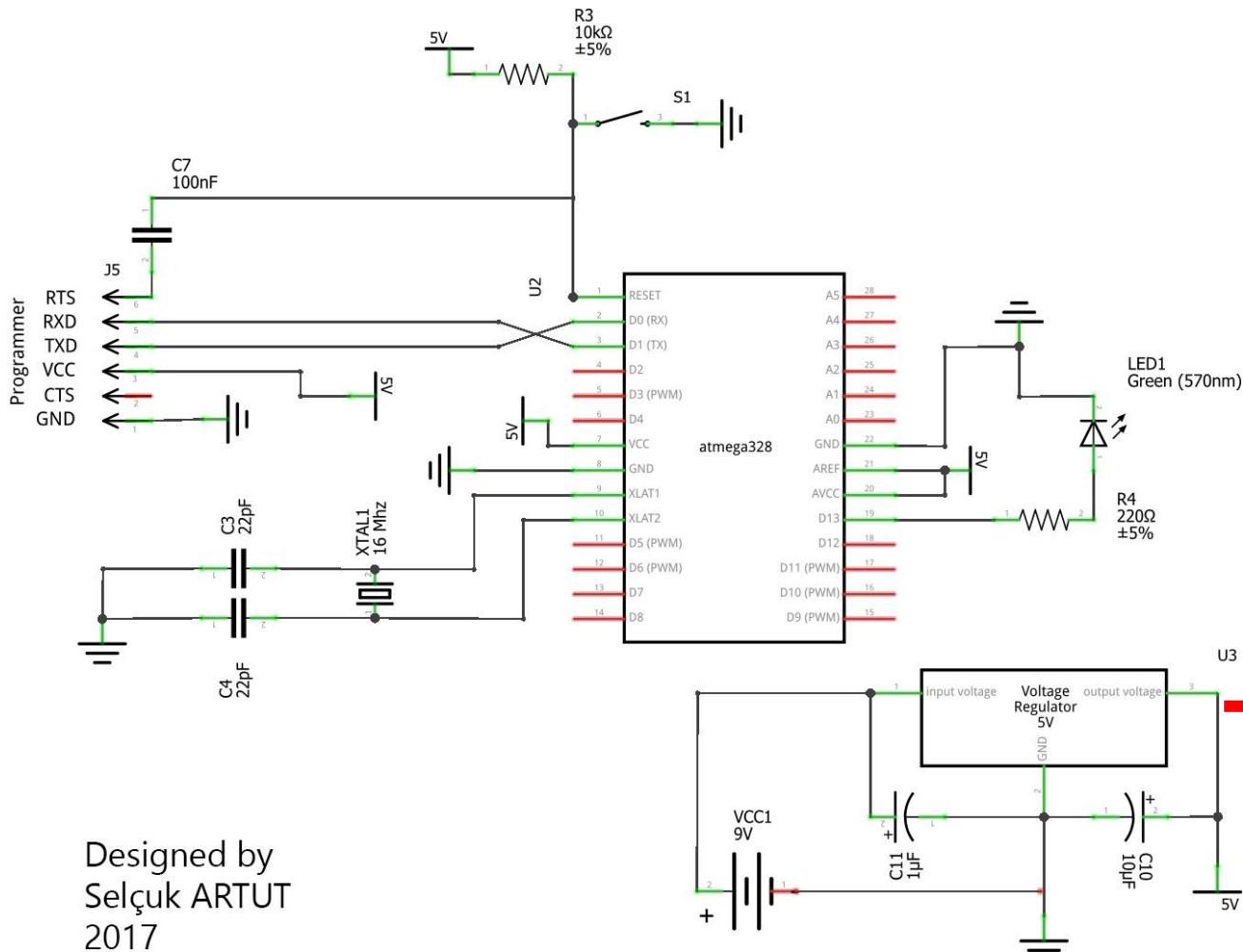
CTS is left empty



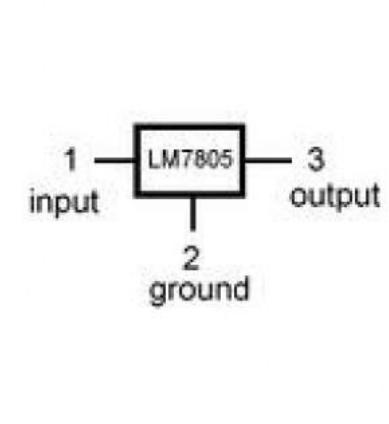
Building your own standalone arduino

Step 11 - External Powering & Voltage Conversion

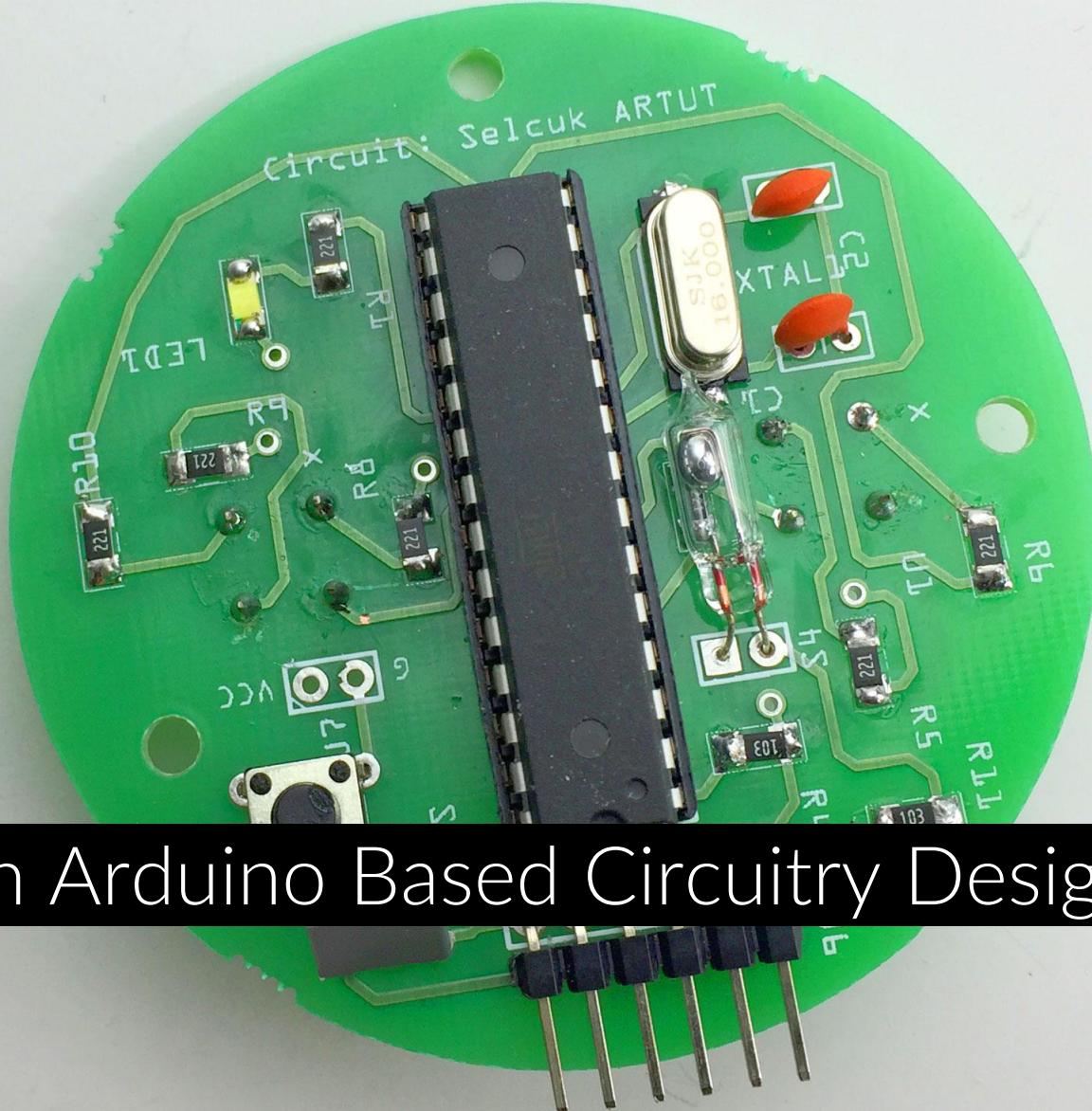
Is it blinking?



LM7805 PINOUT DIAGRAM

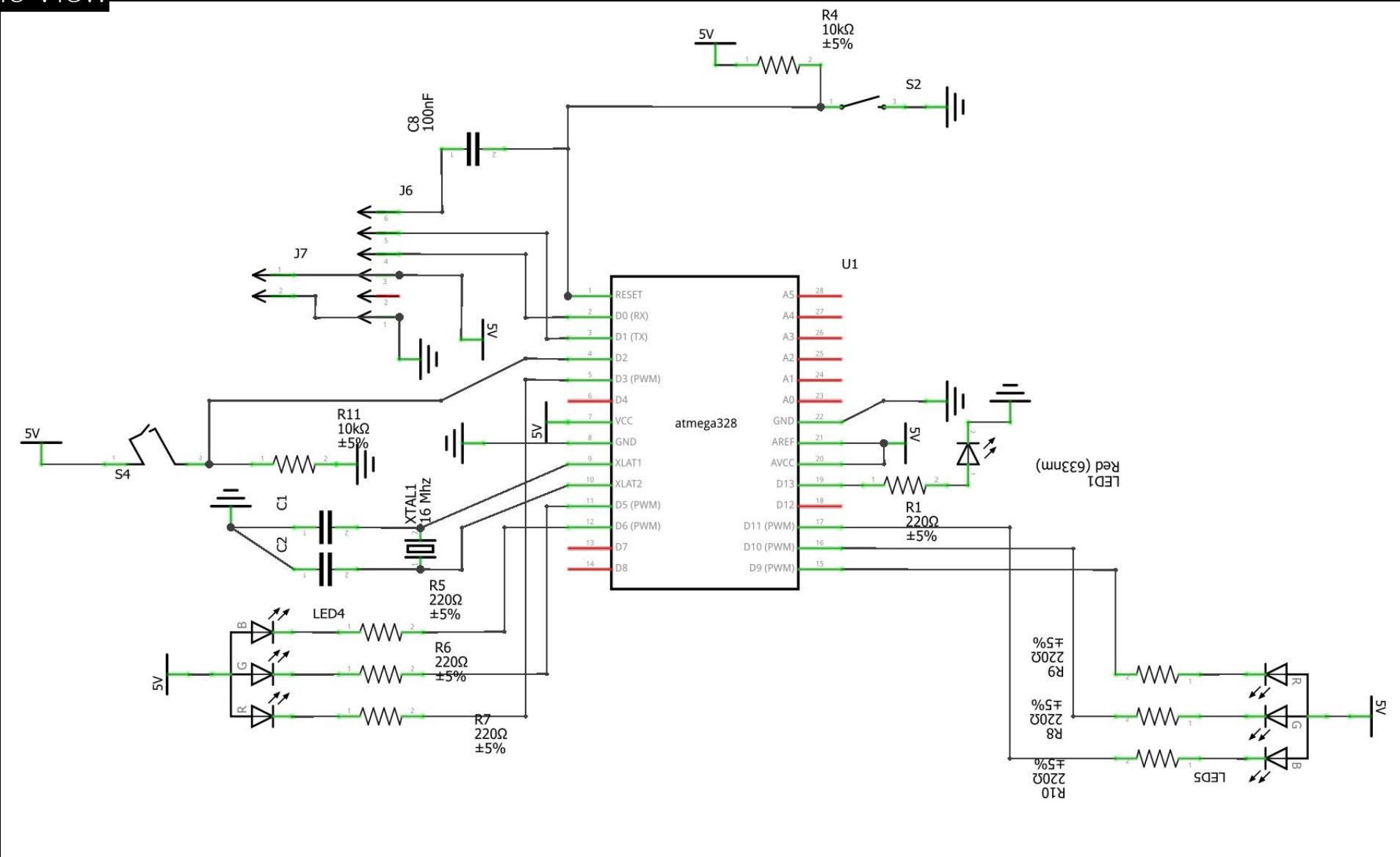


Designed by
Selçuk ARTUT
2017



Part 2 : Building an Arduino Based Circuitry Design

Schematic View



Parts are numbered

Bill of Materials

Assembly List

Label	Part Type	Properties
C1	Capacitor	package cap-pth-small2; variant pth2
C2	Capacitor	package cap-pth-small2; variant pth2
C8	Ceramic Capacitor	package 100 mil [THT, multilayer]; voltage 6.3V; capacitance 100nF
J6	Generic male header - 6 pins	hole size 1.0mm,0.508mm; pin spacing 0.1in (2.54mm); package THT; pins 6; form ♂ (male); row single
J7	Generic male header - 2 pins	hole size 1.0mm,0.508mm; pin spacing 0.1in (2.54mm); package THT; pins 2; form ♂ (male); row single
LED1	Red (633nm) LED	package 1206 [SMD]; color Red (633nm)
LED4	Super Flux RGB LED (com. anode)	type RGB; polarity common anode
LED5	Super Flux RGB LED (com. anode)	type RGB; polarity common anode
R1	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R4	10kΩ Resistor	tolerance ±5%; package 1206 [SMD]; resistance 10kΩ
R5	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R6	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R7	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R8	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R9	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R10	220Ω Resistor	tolerance ±5%; package 1206 [SMD]; resistance 220Ω
R11	10kΩ Resistor	tolerance ±5%; package 1206 [SMD]; resistance 10kΩ
S2	SWITCH-MOMENTARY-2	package tactile-pth; variant pth
S4	Tilt Switch	package THT; tilt mechanism Mechanical Ball

Equipments

1-Atmega329 IC

2-IC Socket

3-Tilt Sensor

4-Push Button

5-Switch

6-Male Header

7-LED (smd)

8-Crystal 16 mhz

9-Flux LED common
anode

10-220 ohm Resistor (smd)

11-22 pF Capacitor

12-100 nf Capacitor

13-10 kOhm Resistor

14-Circuit board



10-220 ohm Resistor



12-100 nF Capacitor



11-22 pF Capacitor



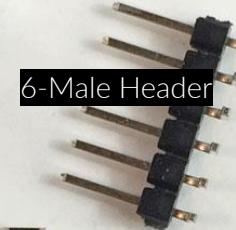
8-Crystal 16 mHz



9-Flux LED



6-Male Header



13-10kOhm Resistor



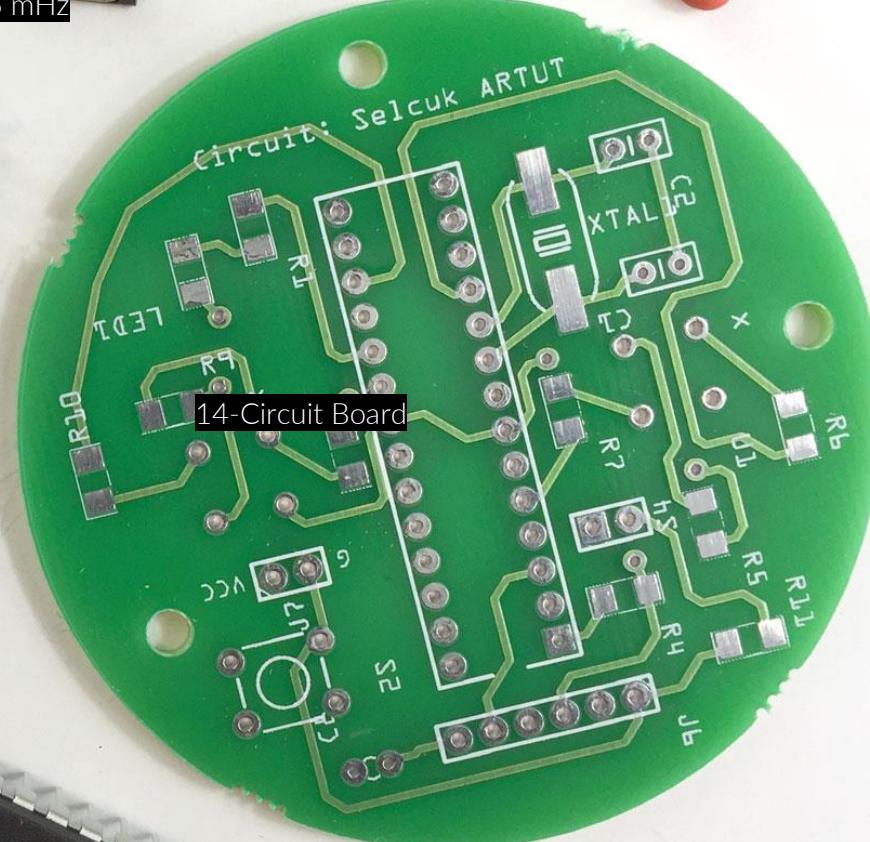
7-LED(smd)



3-Tilt Sensor



1-Atmega329 IC

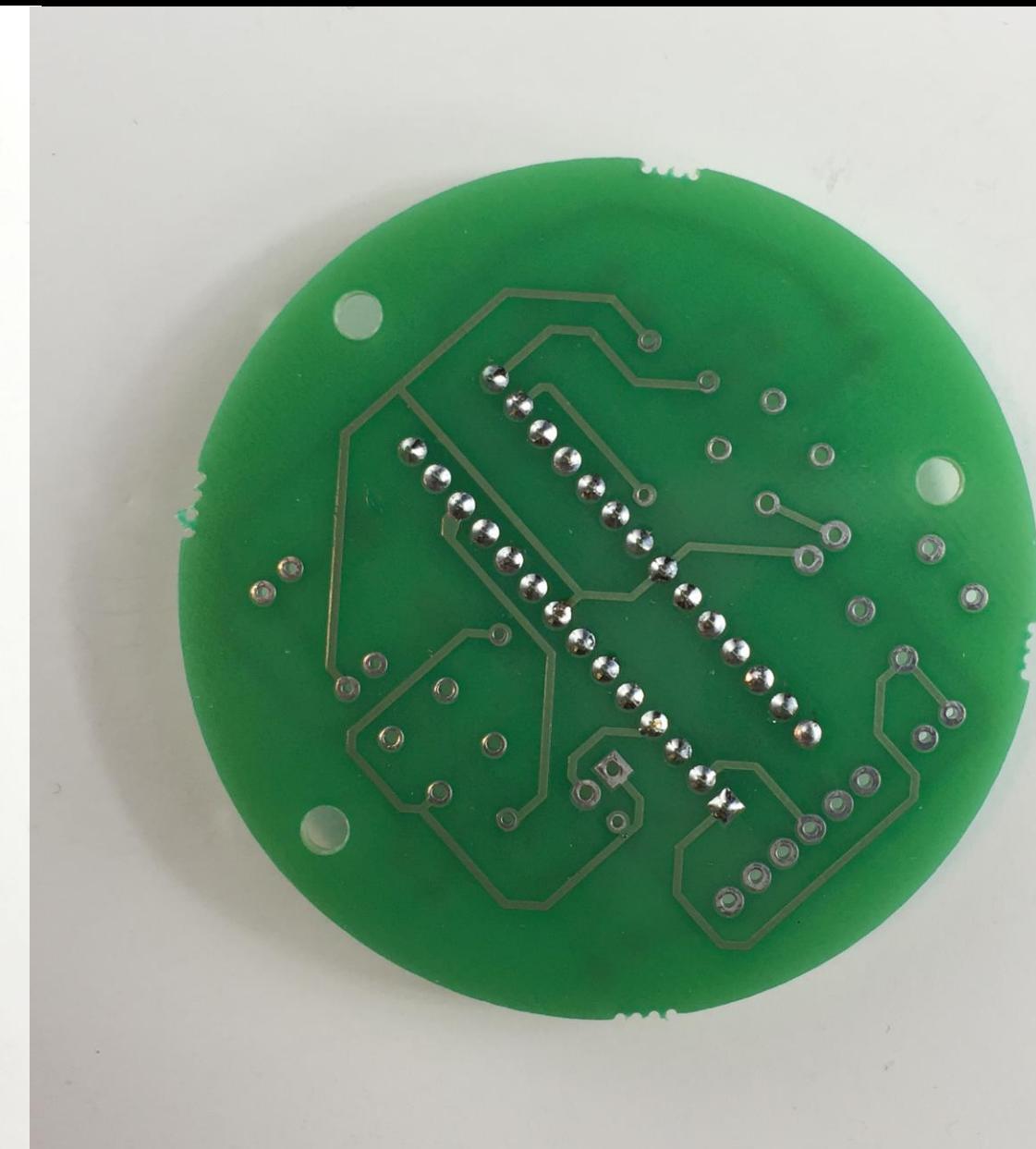
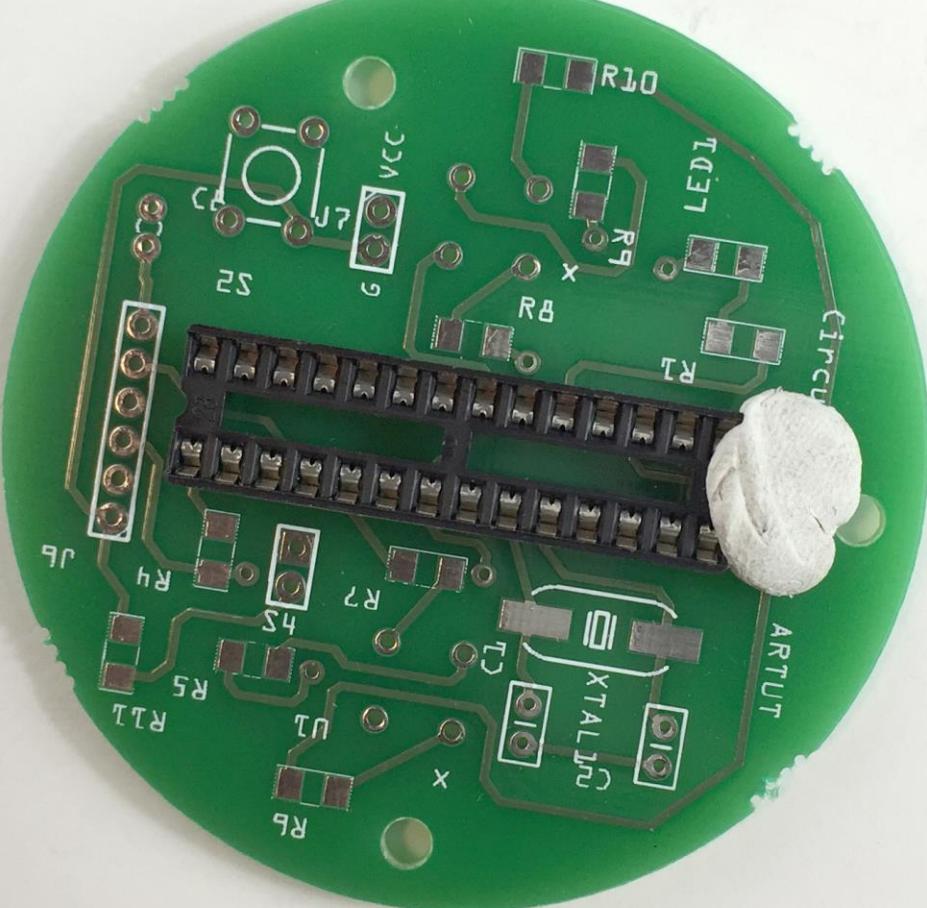


5-Switch



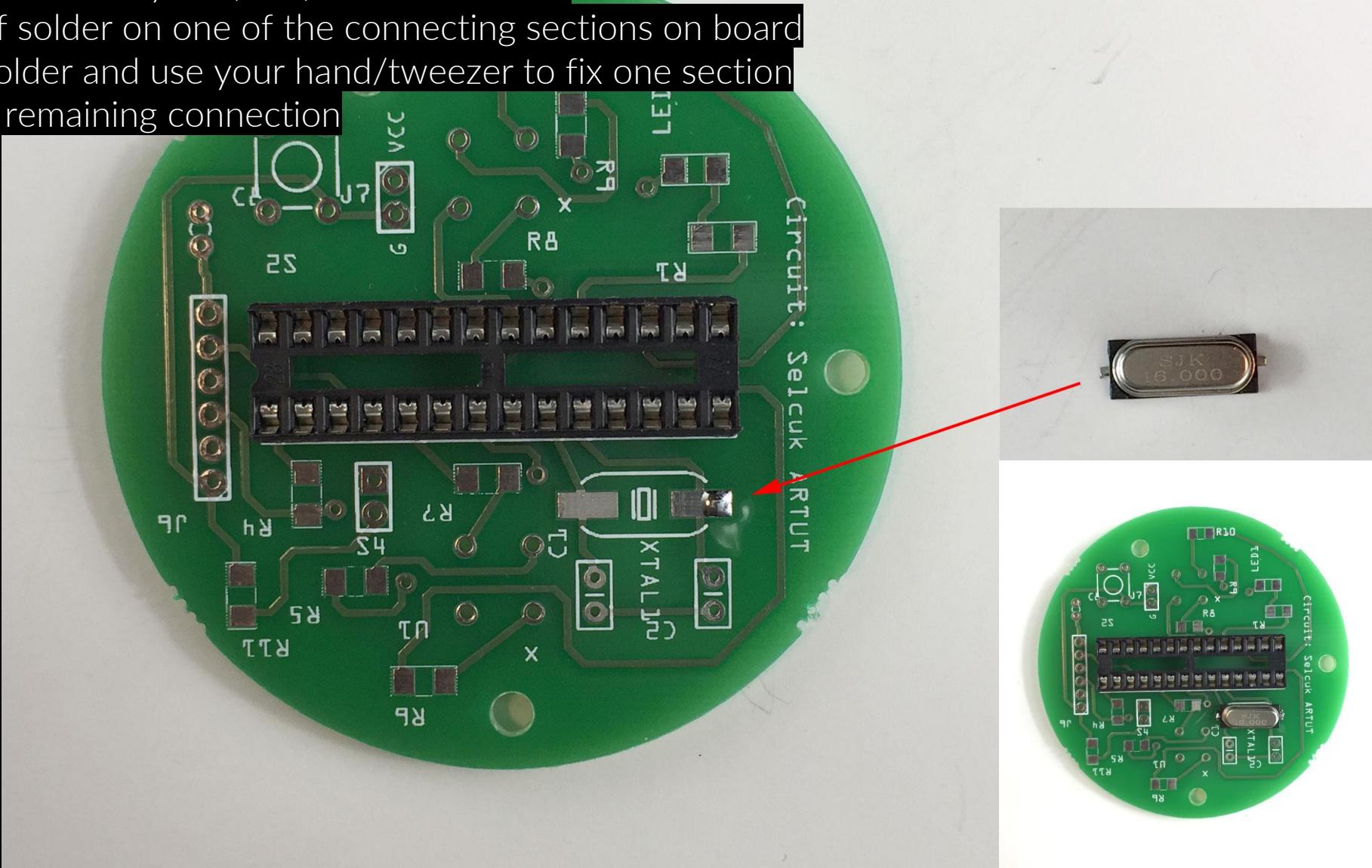
4-Push Button

Step 1 : Solder the IC Socket to Circuit Board
Use tack it to fix the components



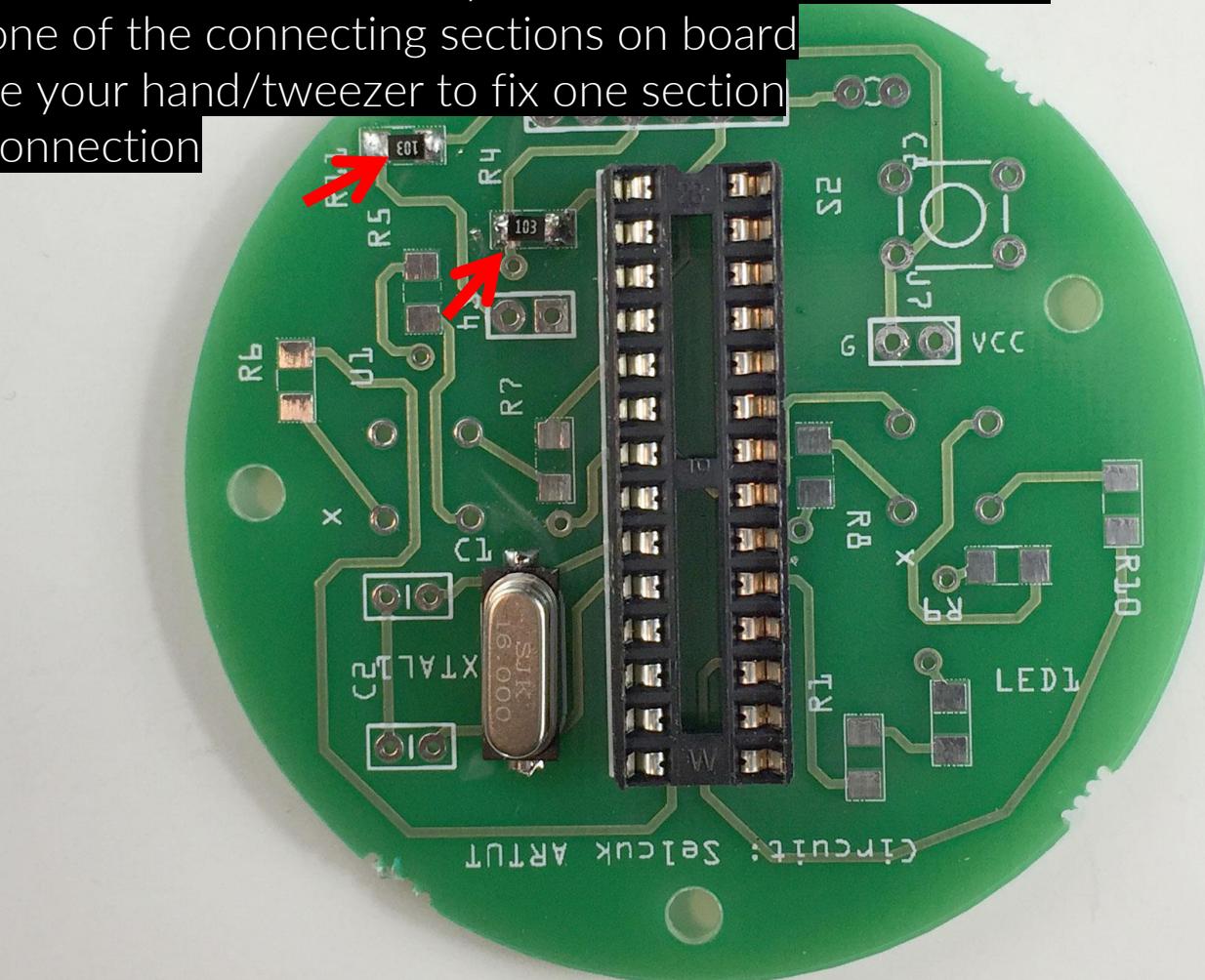
Step 2 : Solder the Crystal (smd) to Circuit Board

- Put a bit of solder on one of the connecting sections on board
- Melt the solder and use your hand/tweezer to fix one section
- Solder the remaining connection



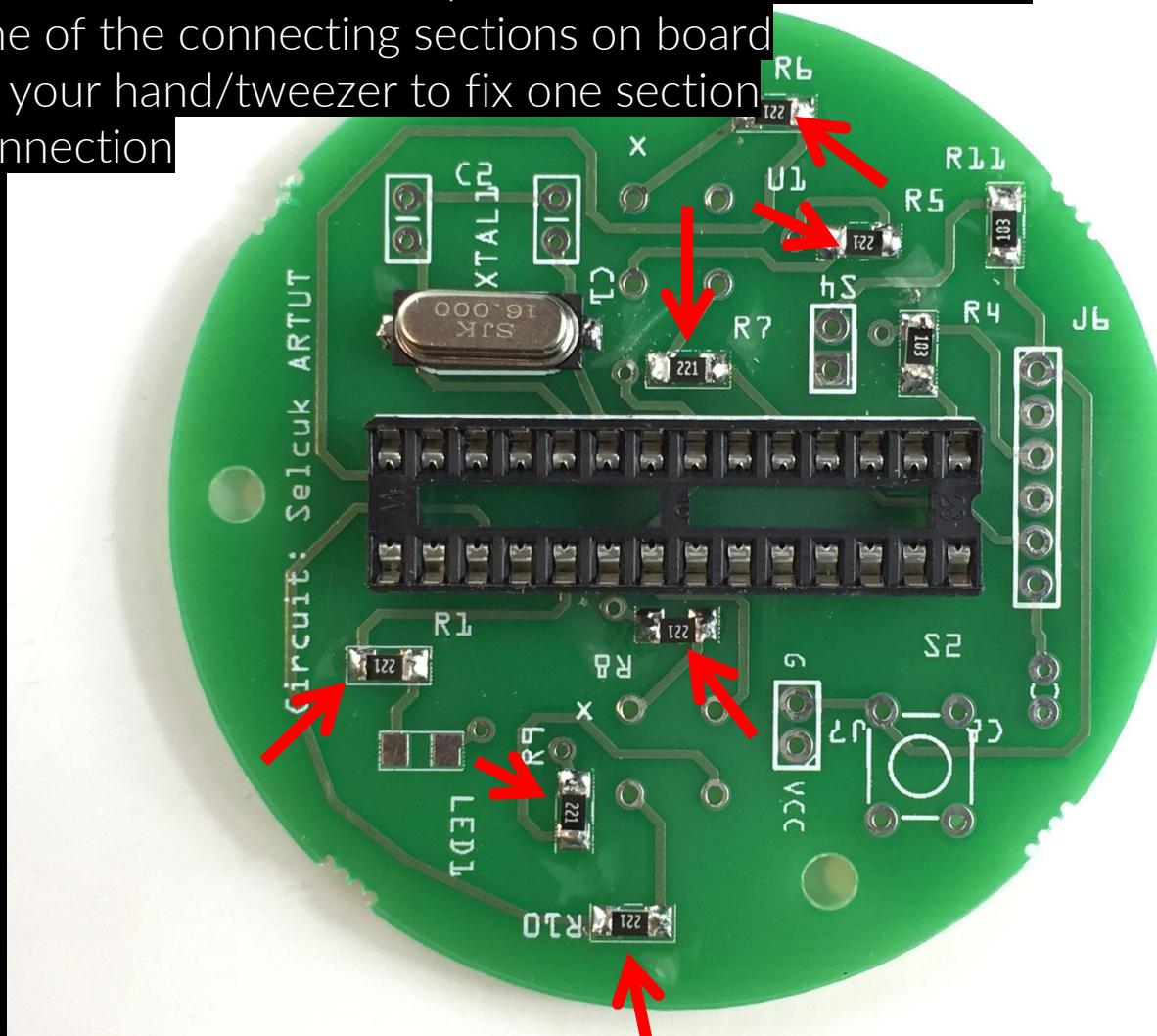
Step 4 : Solder the 10kOhm Resistor (smd-it says 103 on it) to Circuit Board

- Put a bit of solder on one of the connecting sections on board
- Melt the solder and use your hand/tweezer to fix one section
- Solder the remaining connection



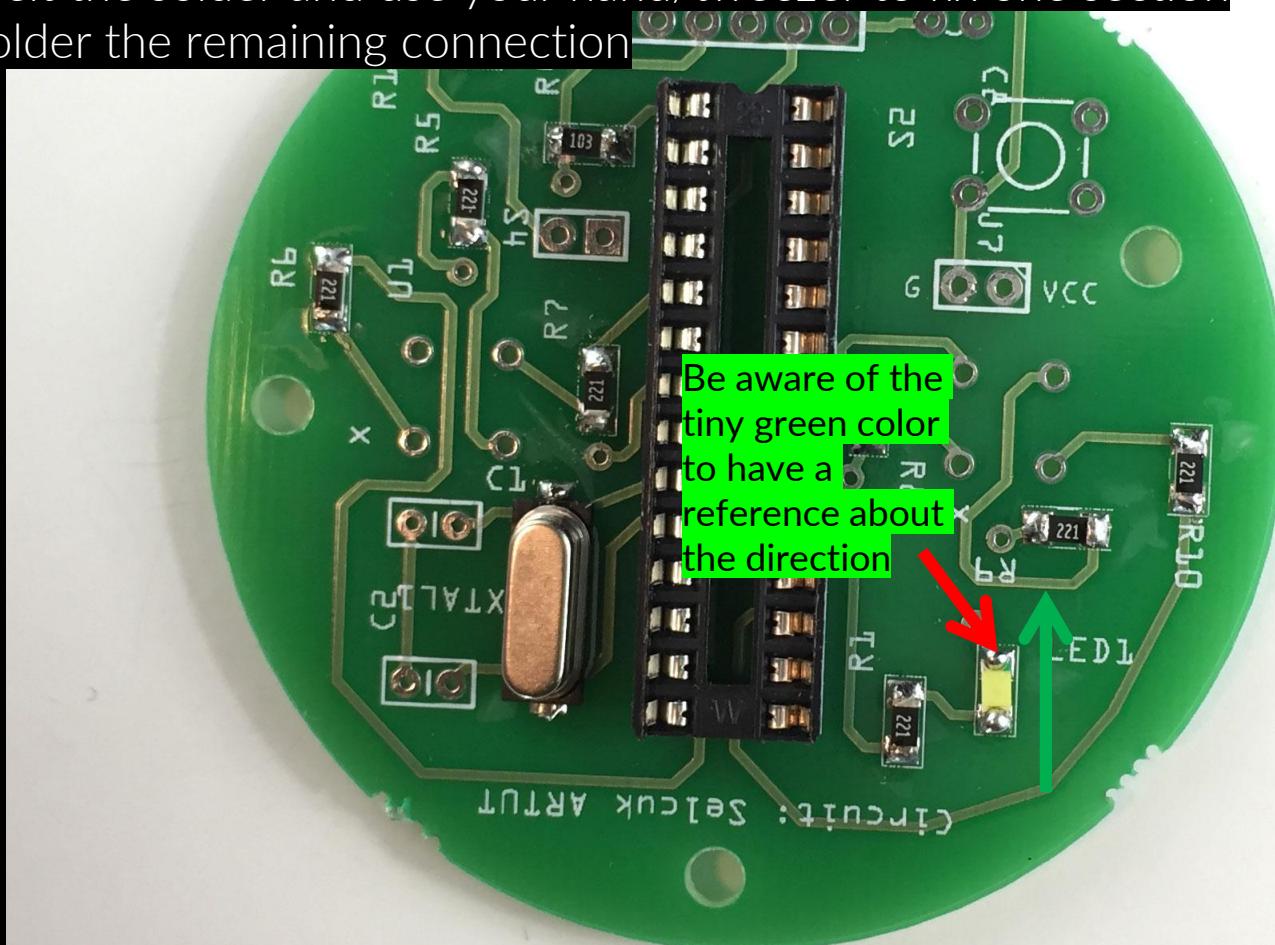
Step 5 : Solder the 220 ohm Resistor (smd-it says 221 on it) to Circuit Board

- Put a bit of solder on one of the connecting sections on board
- Melt the solder and use your hand/tweezer to fix one section
- Solder the remaining connection



Step 6 : Solder the 220 ohm Resistor (smd-it says 221 on it) to Circuit Board

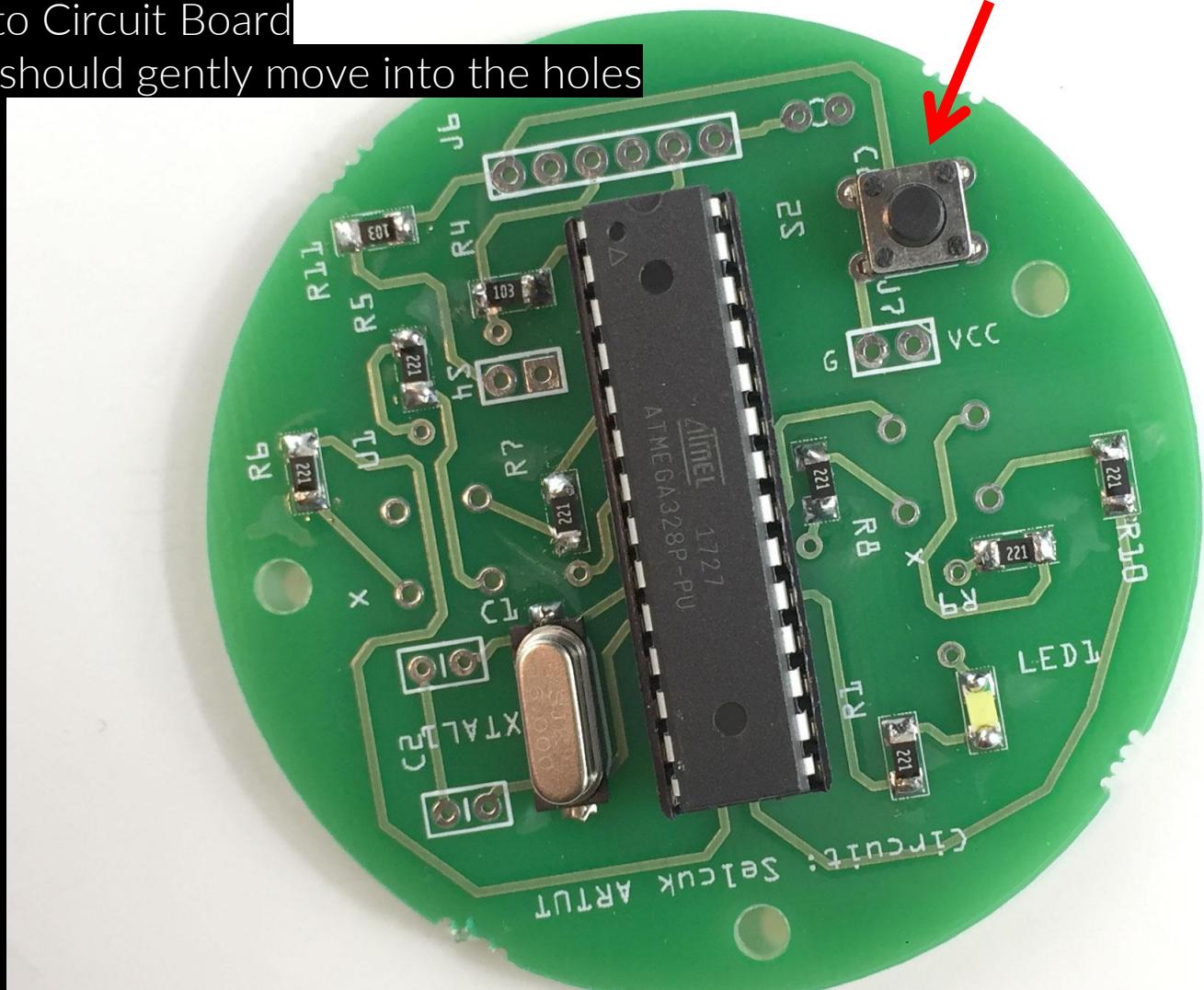
- Put a bit of solder on one of the connecting sections on board
- Melt the solder and use your hand/tweezer to fix one section
- Solder the remaining connection



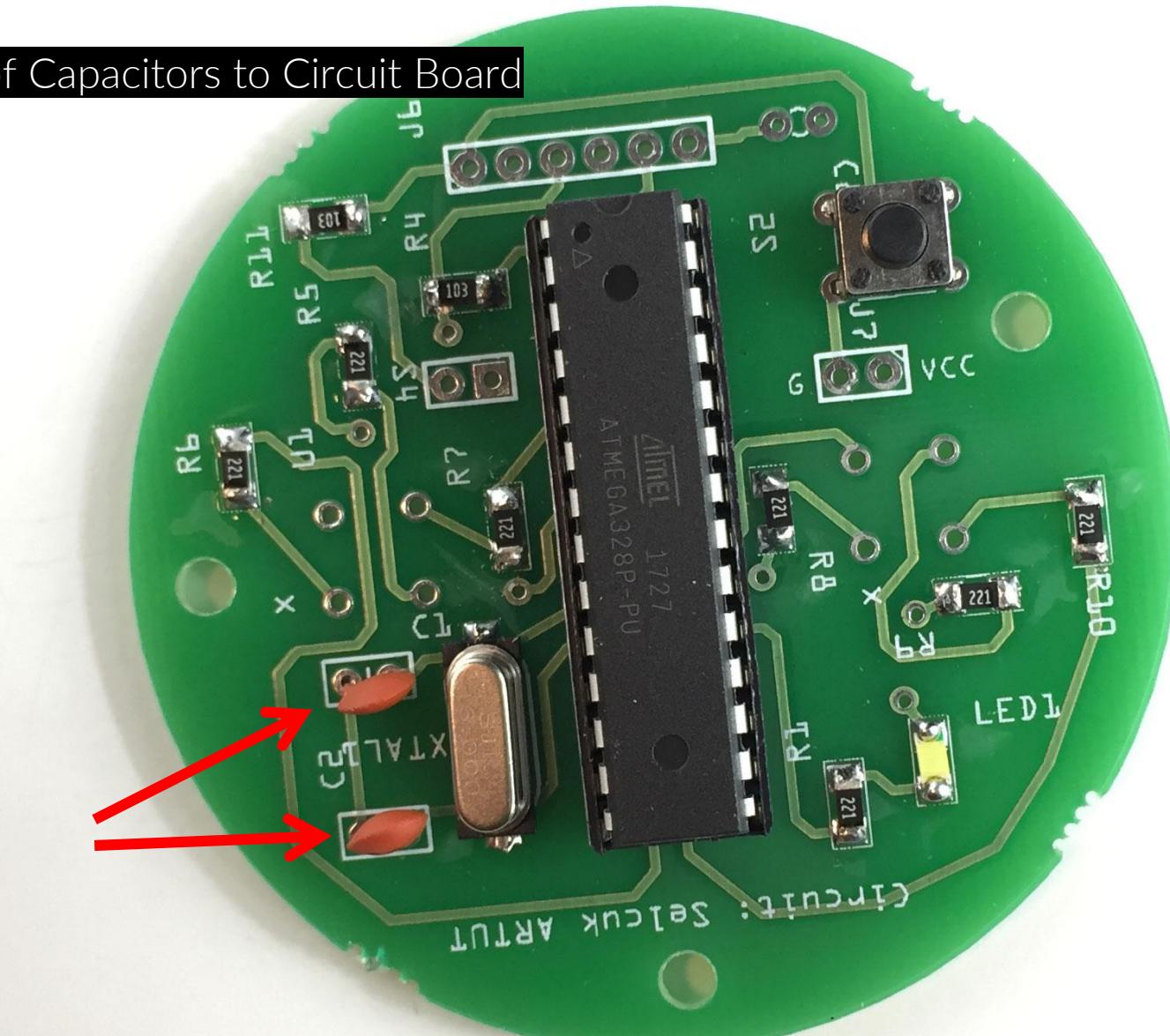
LED current direction

Step 7 : Solder the Push Button to Circuit Board

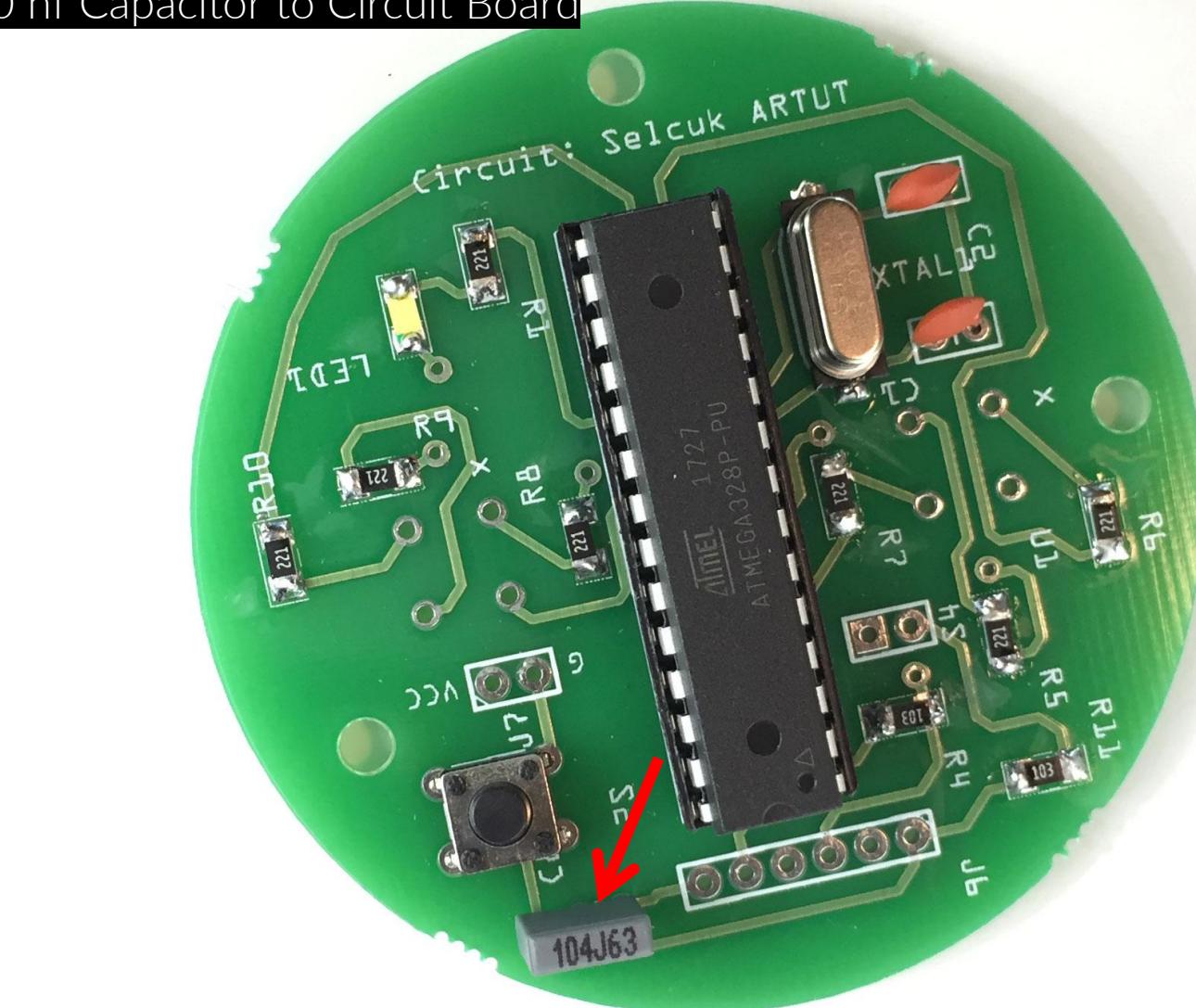
- Be aware of its leg positions, it should gently move into the holes



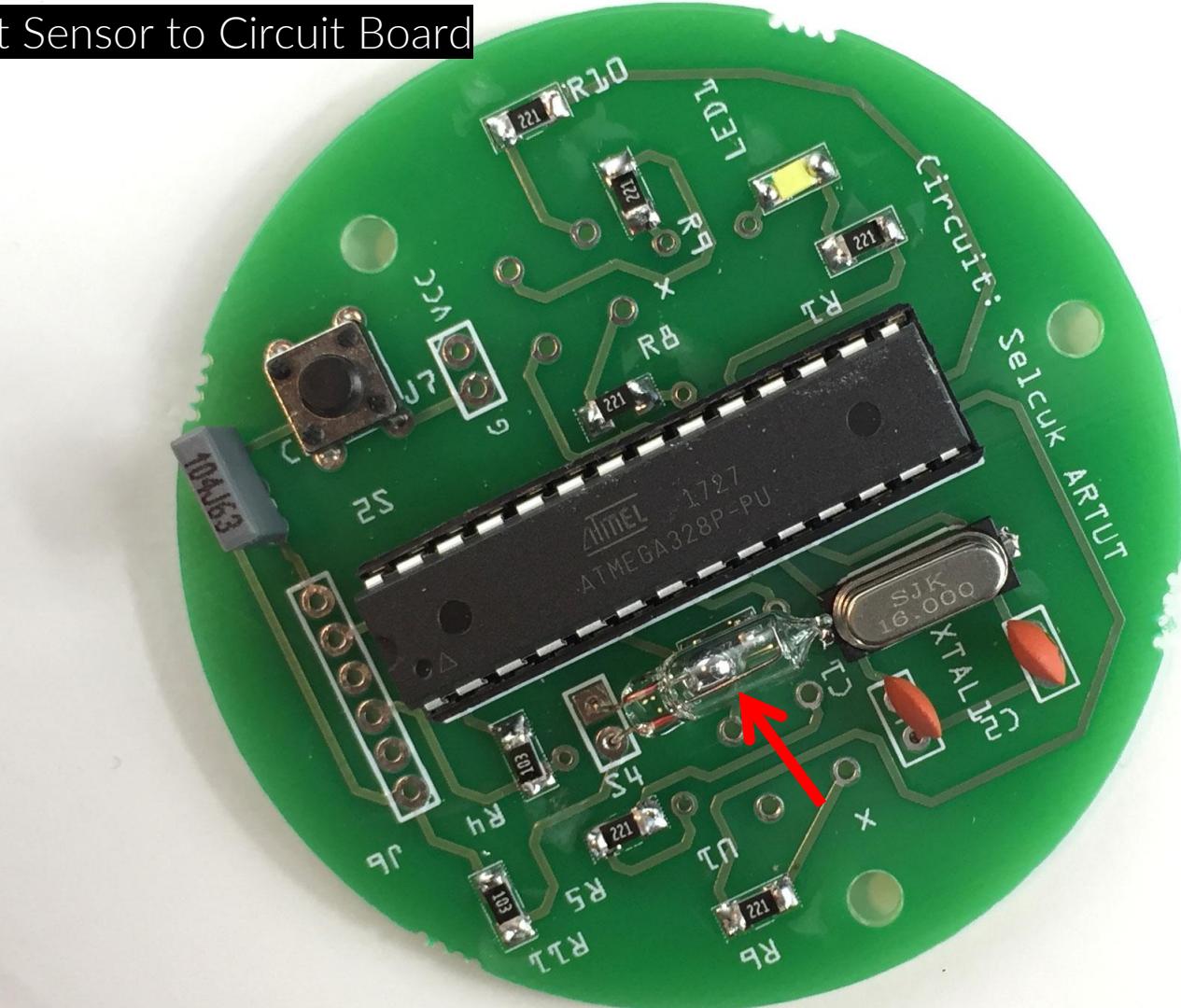
Step 8 : Solder the 22 pf Capacitors to Circuit Board



Step 9 : Solder the 100 nf Capacitor to Circuit Board

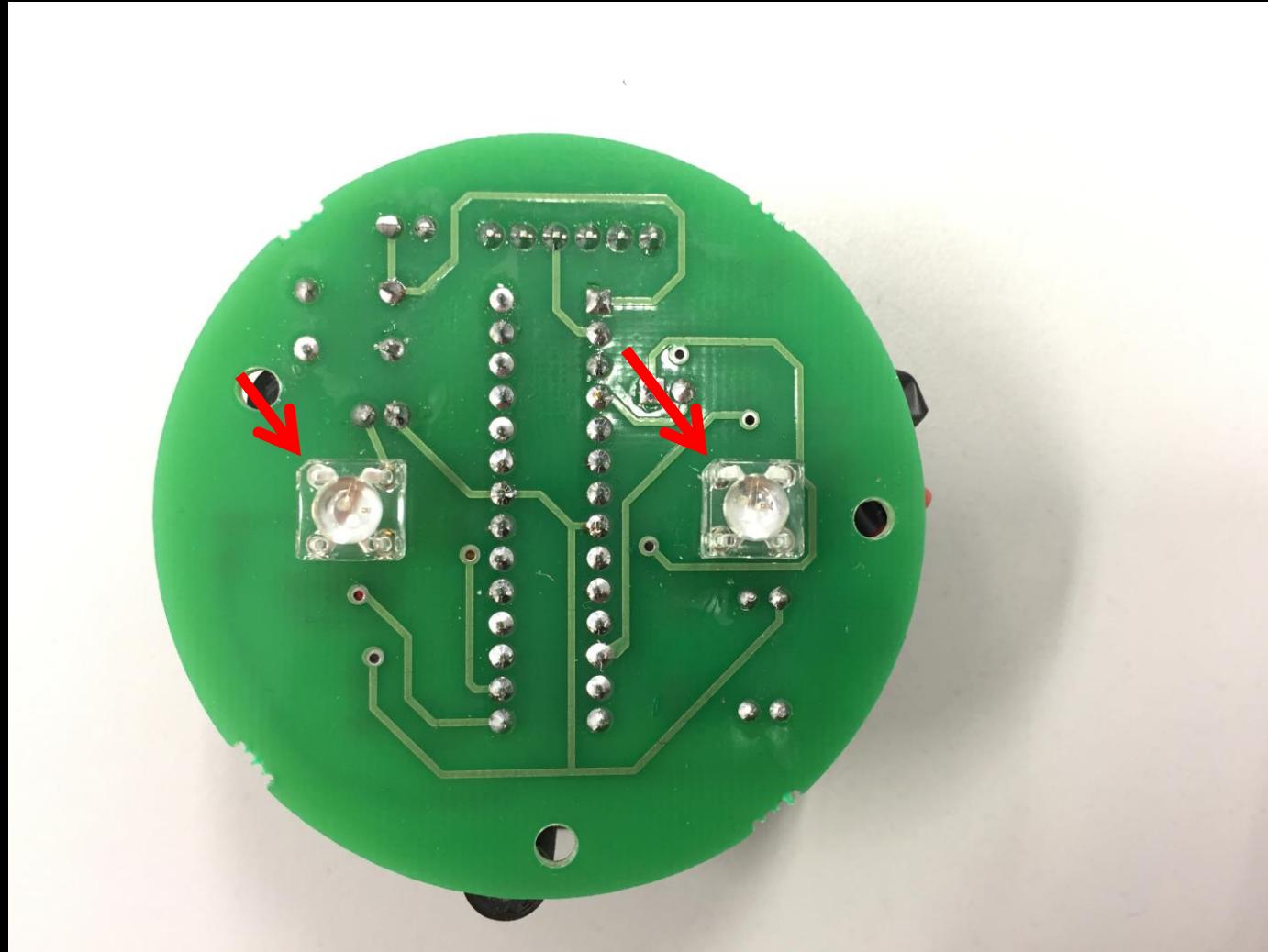


Step 10 : Solder the Tilt Sensor to Circuit Board



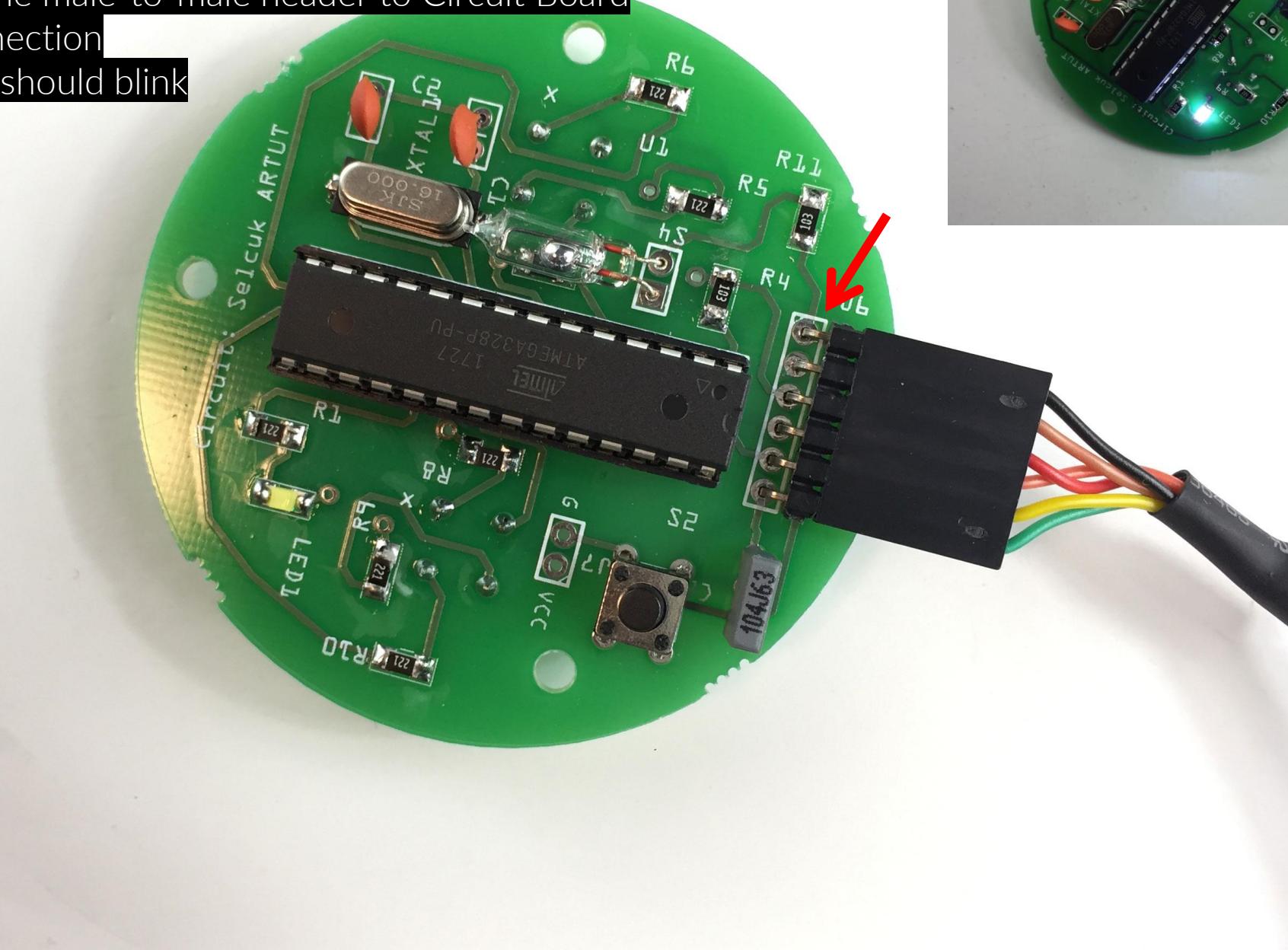
Step 11 : Solder the flux leds to Circuit Board

- Be aware of the sliced edge for the positioning



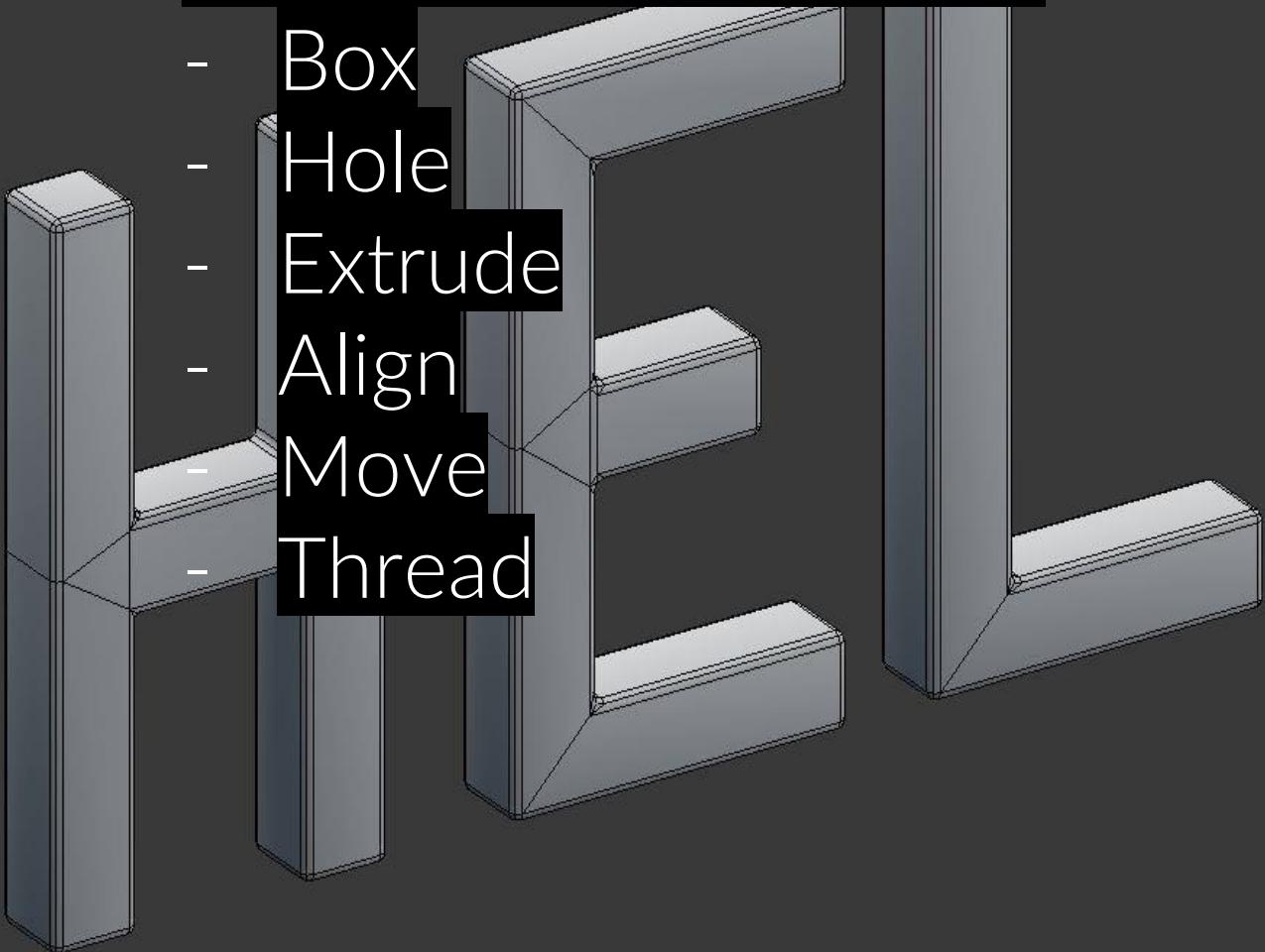
Step 12 : Solder the male-to-male header to Circuit Board

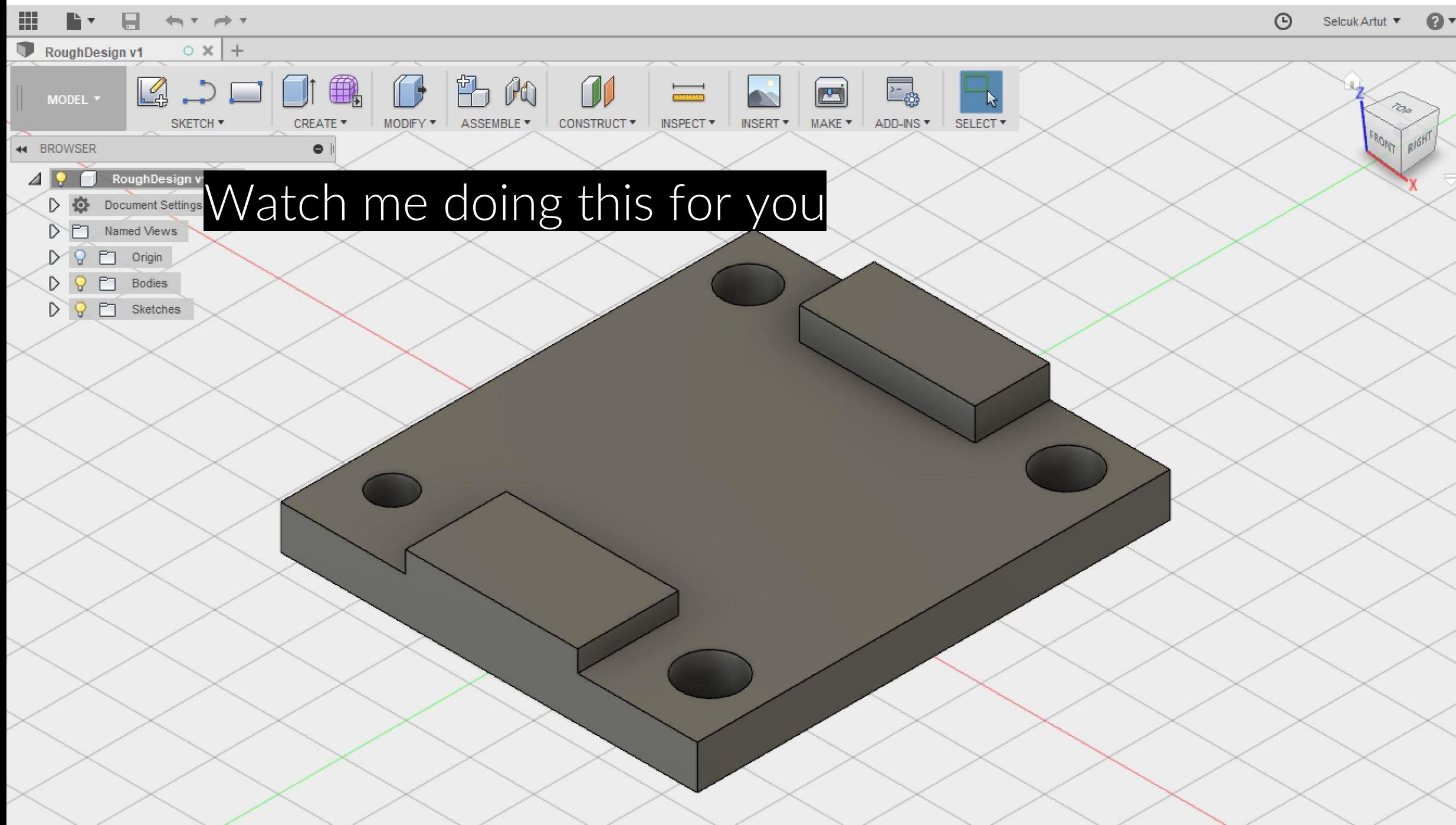
- Apply ftdi connection
- if all is good, it should blink



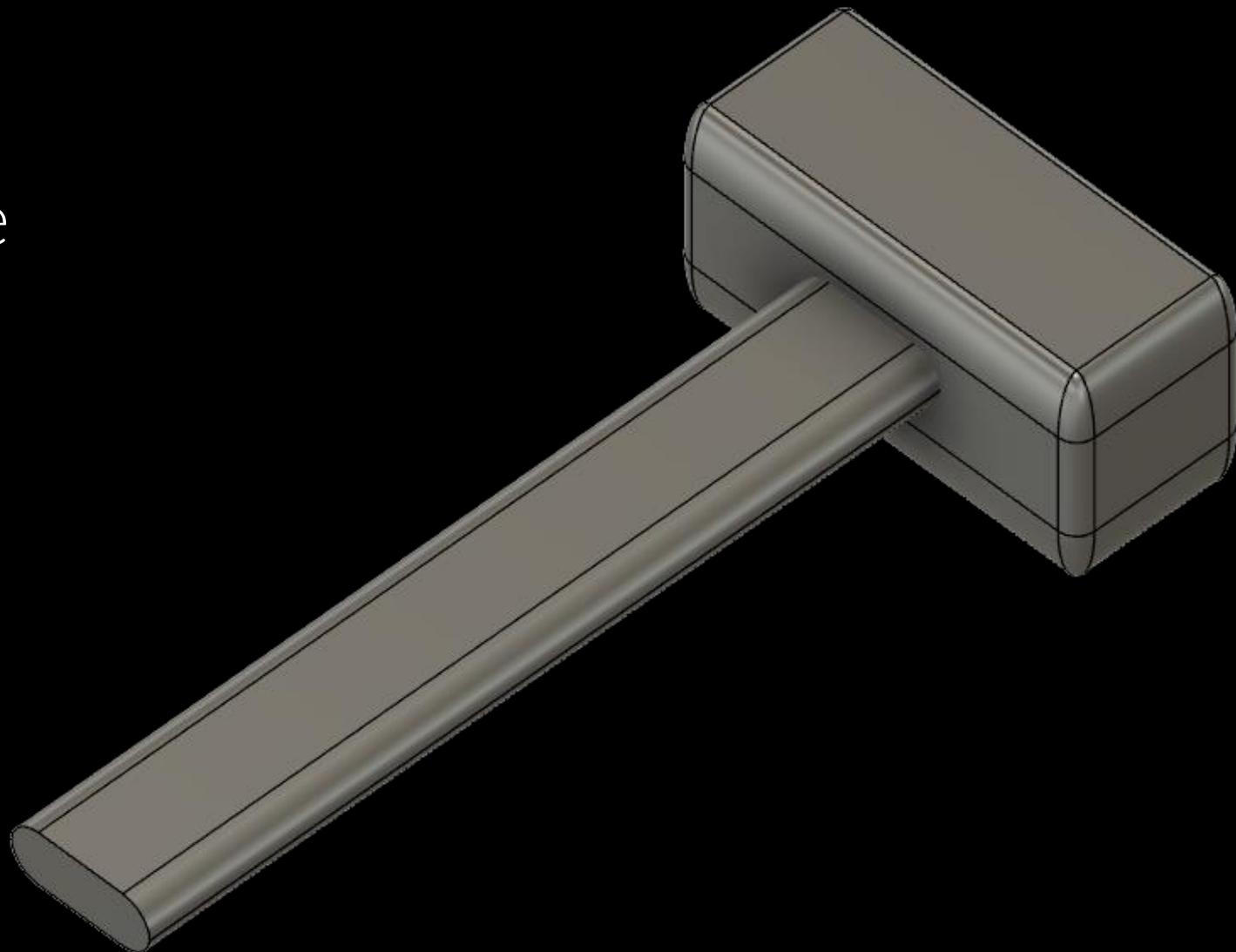
Fusion 360 - Essentials

- Box
- Hole
- Extrude
- Align
- Move
- Thread





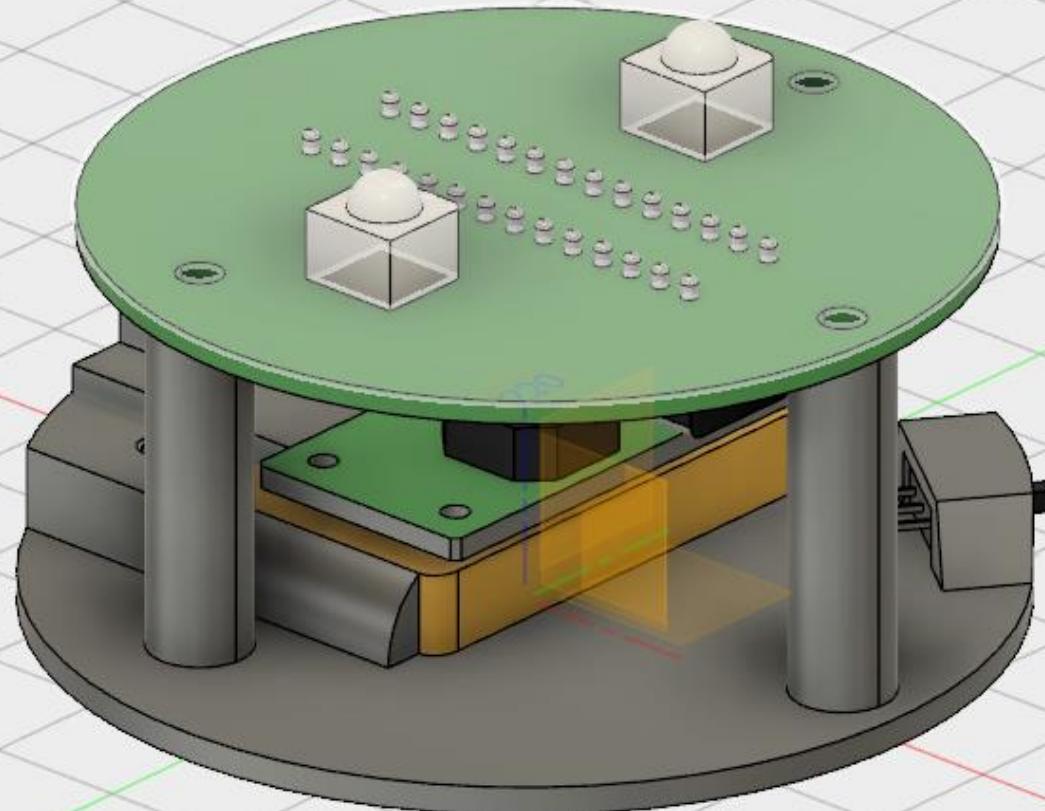
Hammer time



Part 3 : Accurate Prototyping - Designing an Enclosure

A Workflow Proposal

Final Stage





FUSION 360

SUPPORT & LEARNING

COMMUNITY

STUDENTS

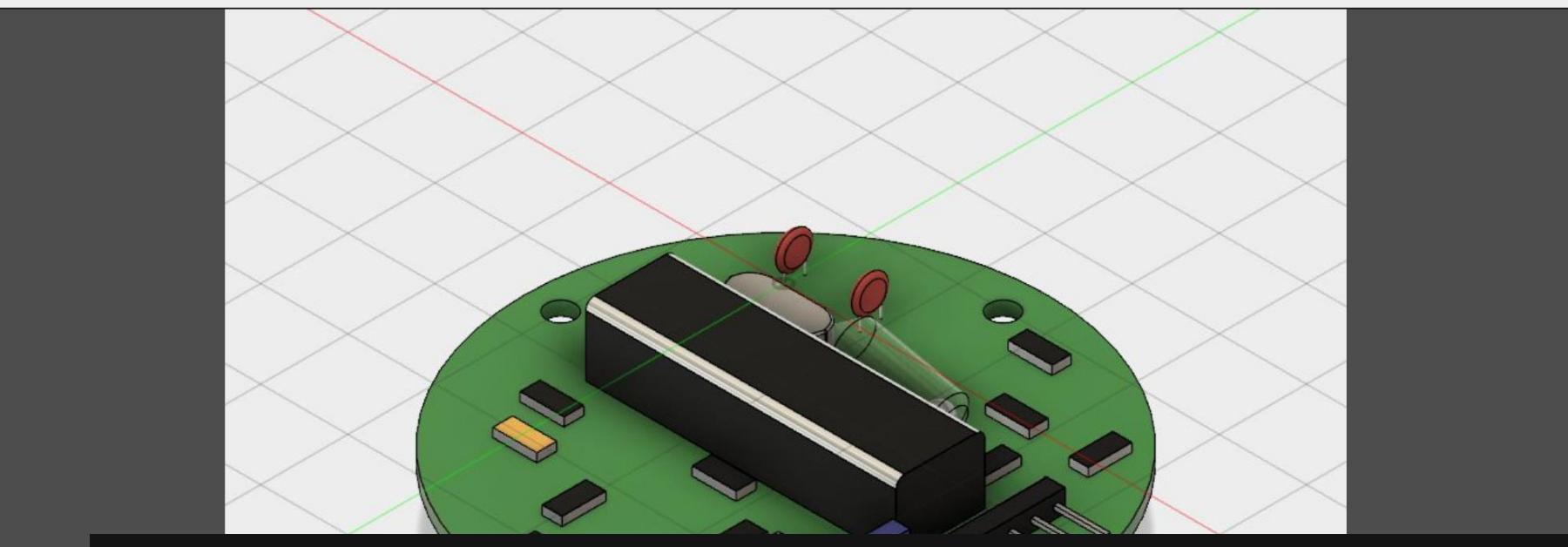
COMPARE

SUBSCRIBE

FREE TRIAL

RGB Tilt Workshop Project

3/27/2018



Selcuk ARTUT

ISTANBUL, ISTANBUL,
TURKEY



OPEN/DOWNLOAD THE MODEL



Like



Share

Statistics



58

0

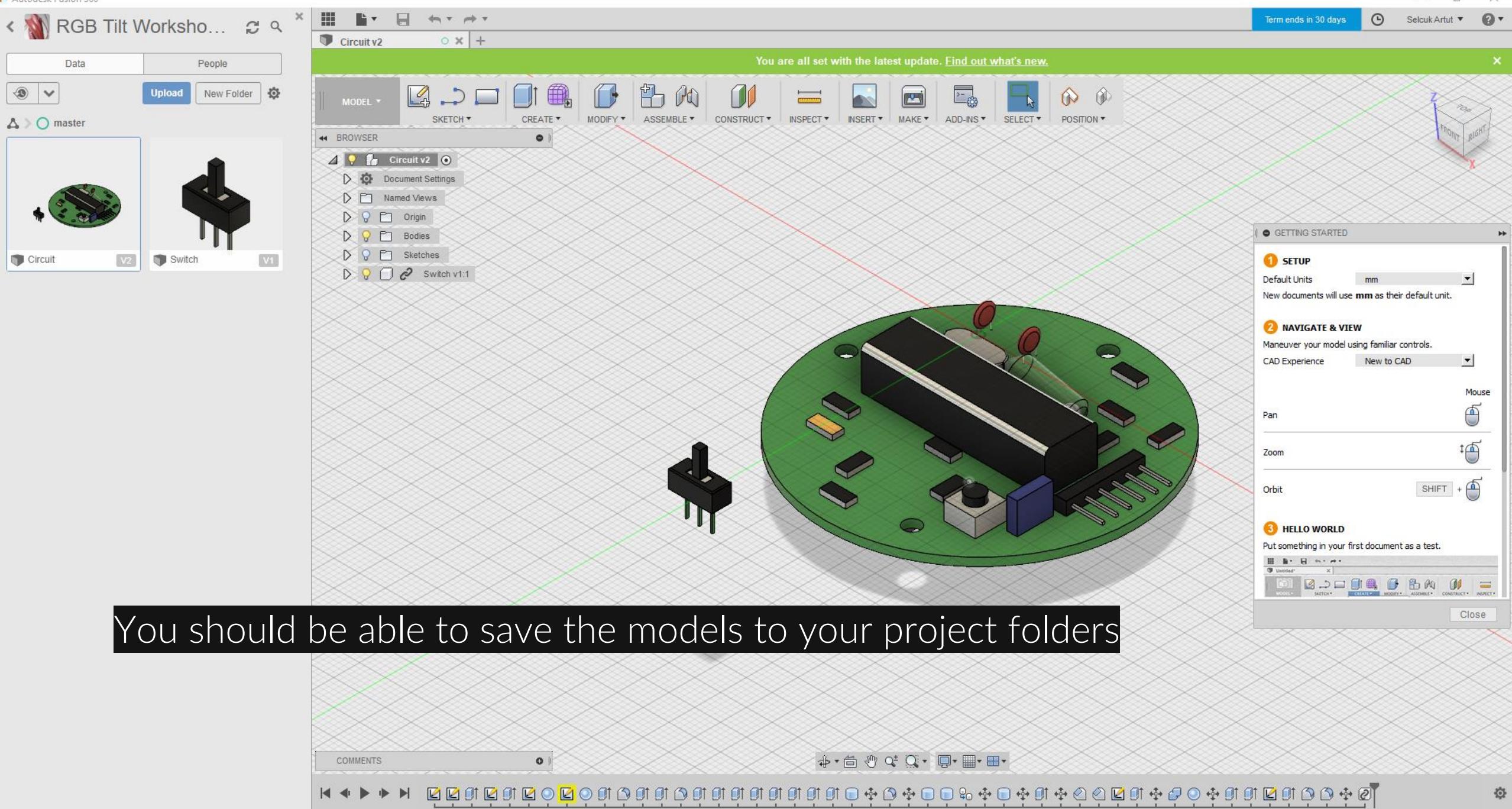
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Industries

Media & Entertainment

Product Design & Manufacturing

<https://gallery.autodesk.com/fusion360/projects/rgb-tilt-workshop-project>



You should be able to save the models to your project folders

FUSION 360

SUPPORT & LEARNING

COMMUNITY

STUDENTS

COMPARE

SUBSCRIBE

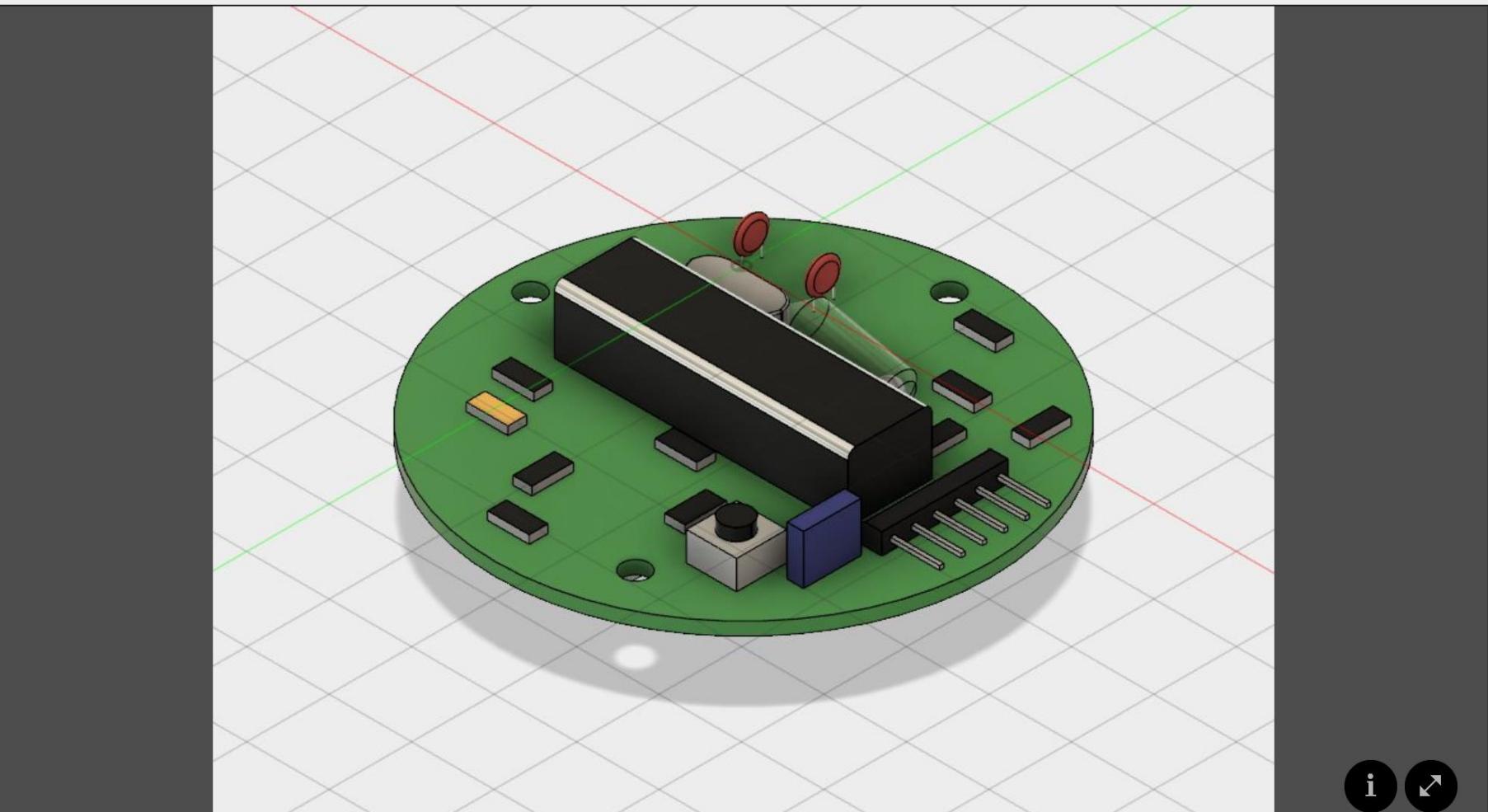
FREE TRIAL



ENGLISH

RGB Tilt Workshop Project

3/27/2018



Selcuk ARTUT

ISTANBUL, ISTANBUL,
TURKEY



OPEN/DOWNLOAD THE MODEL



Like



Share

Statistics



58



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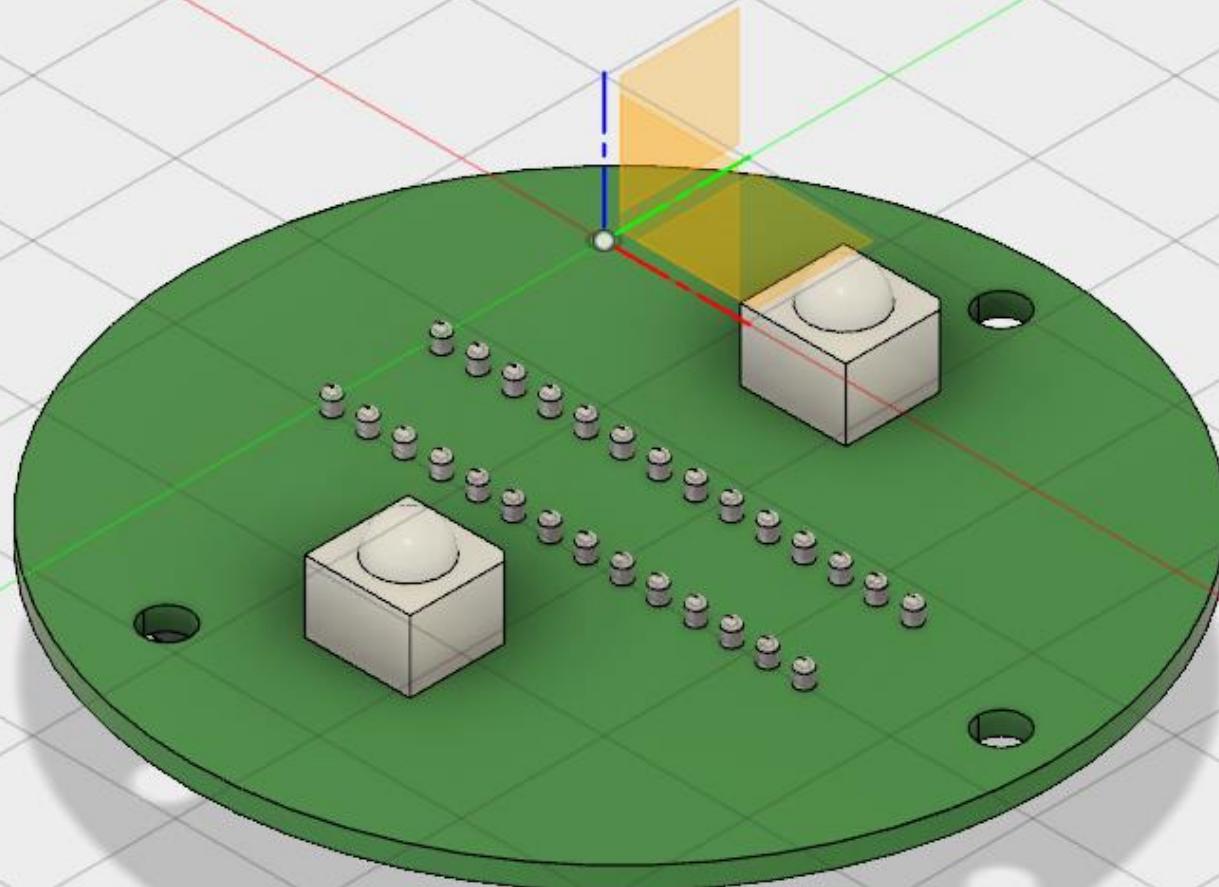
Industries

Media & Entertainment

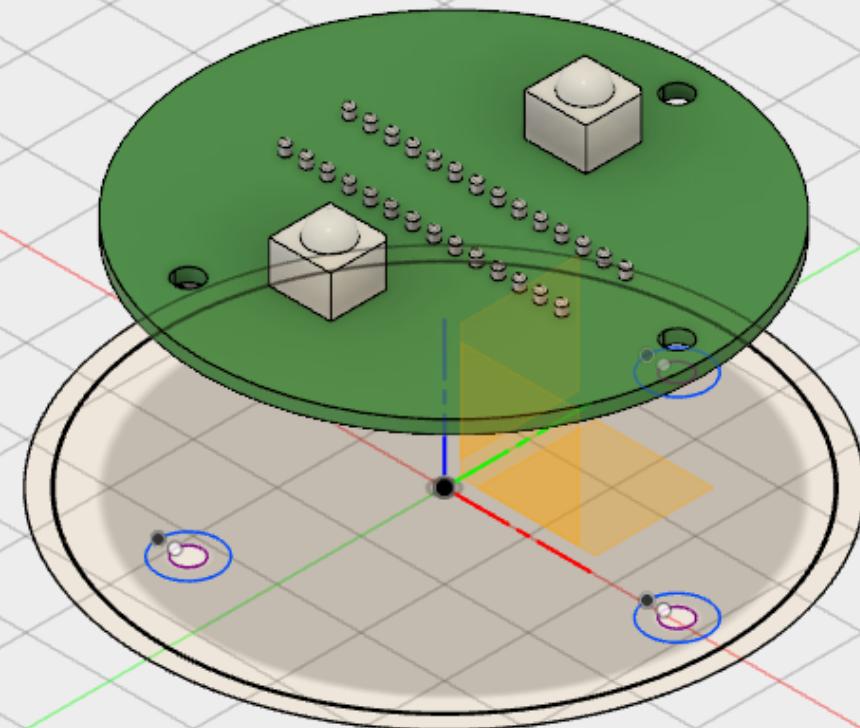
Product Design & Manufacturing



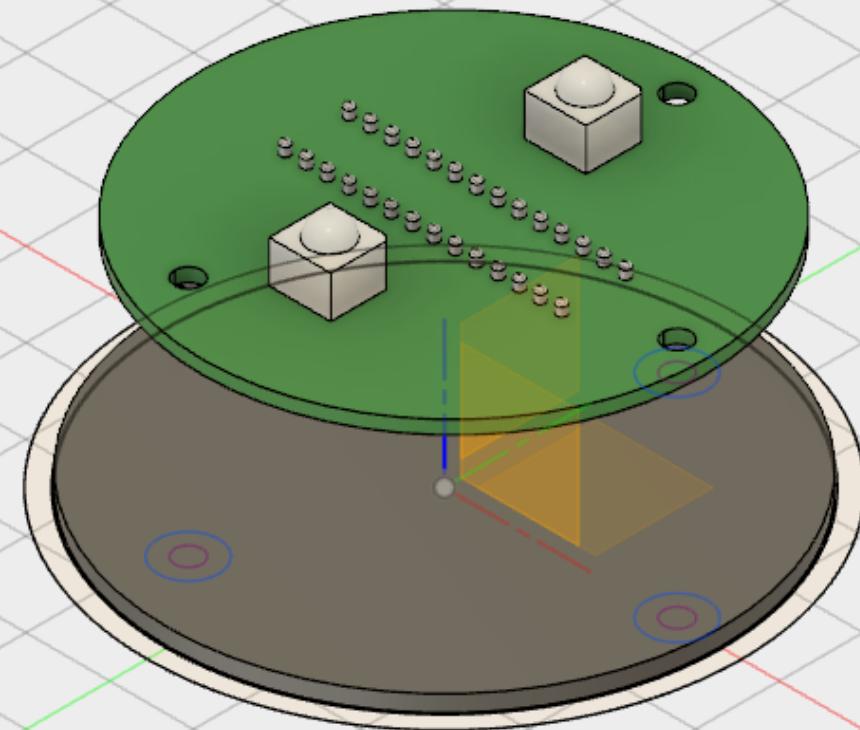
Bring the circuitry to the stage



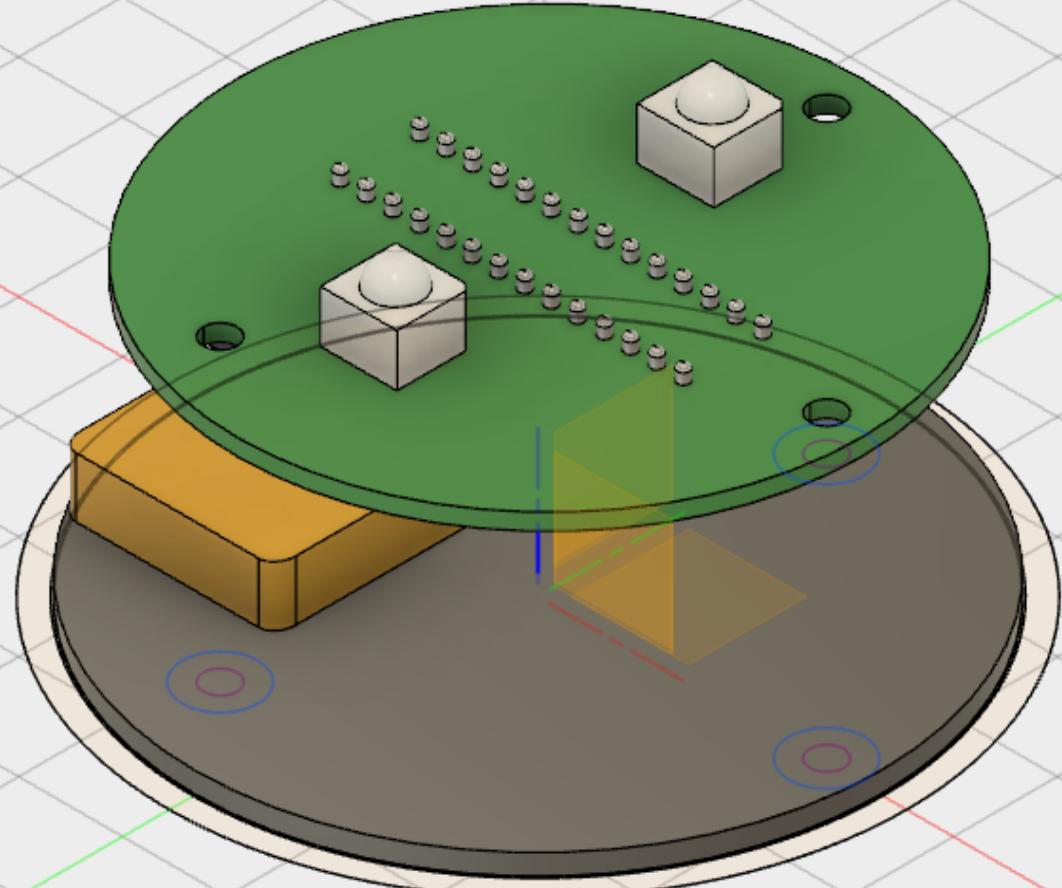
Move it to right location



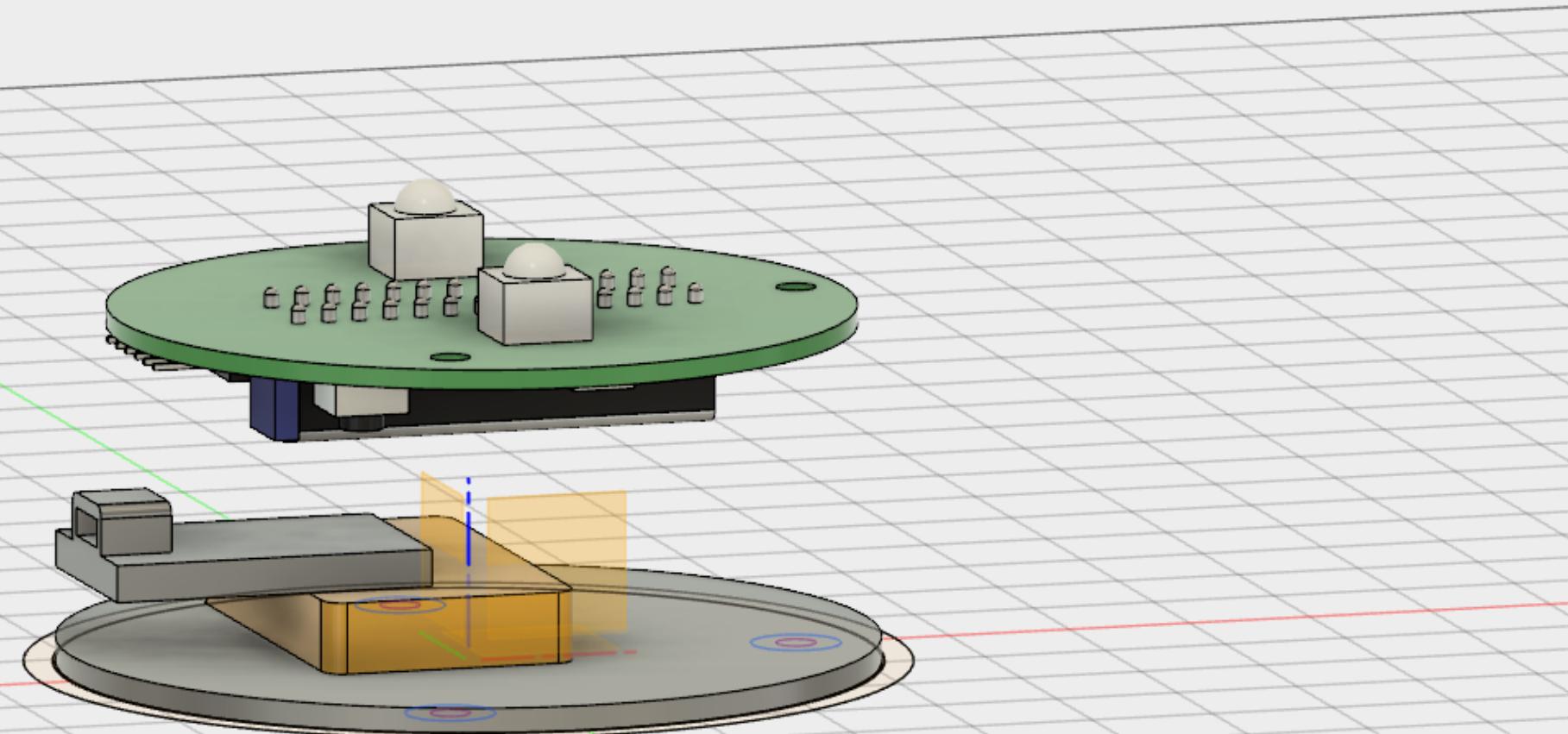
Extrude the base



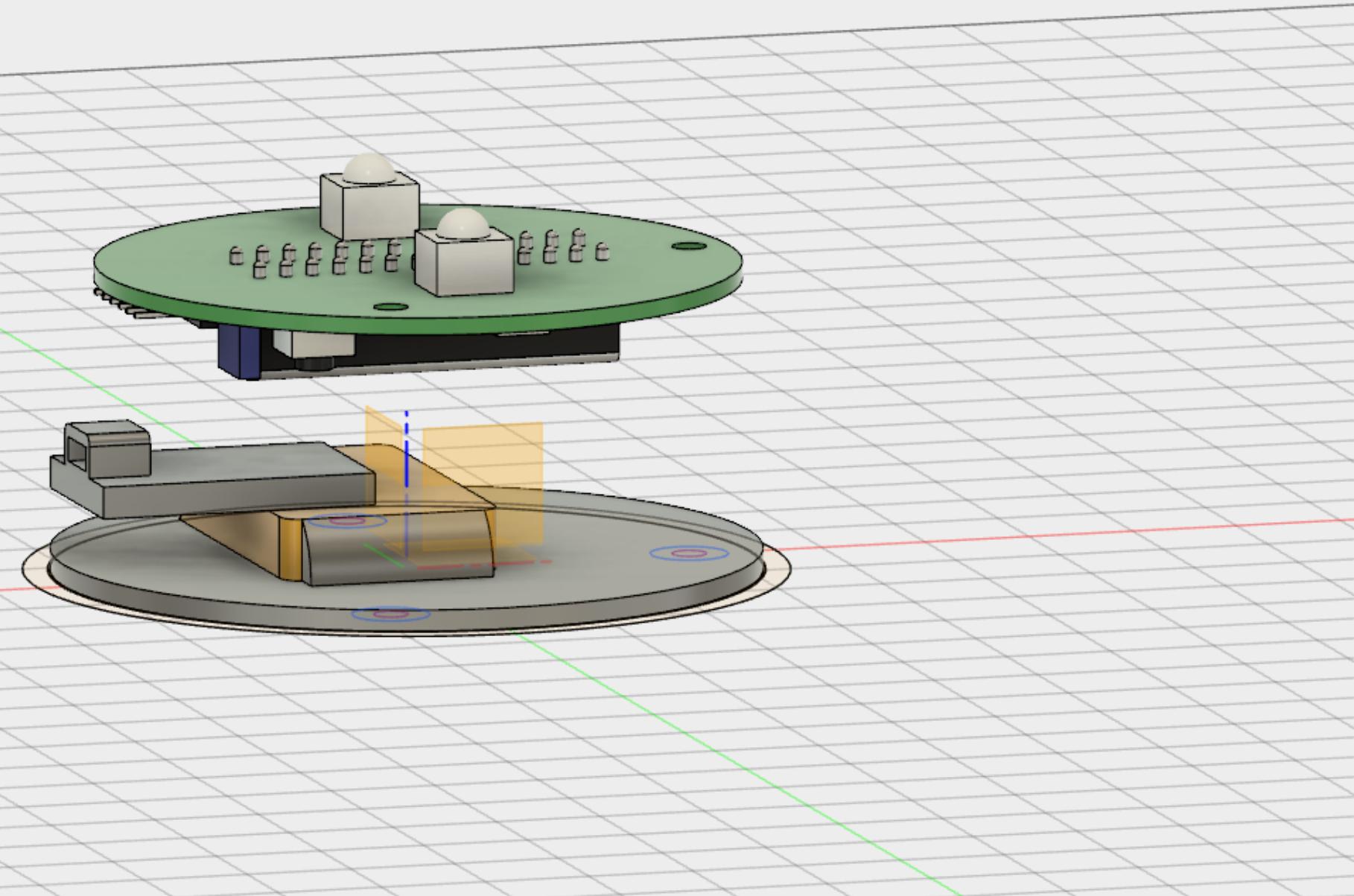
Place the Lipo Battery in place



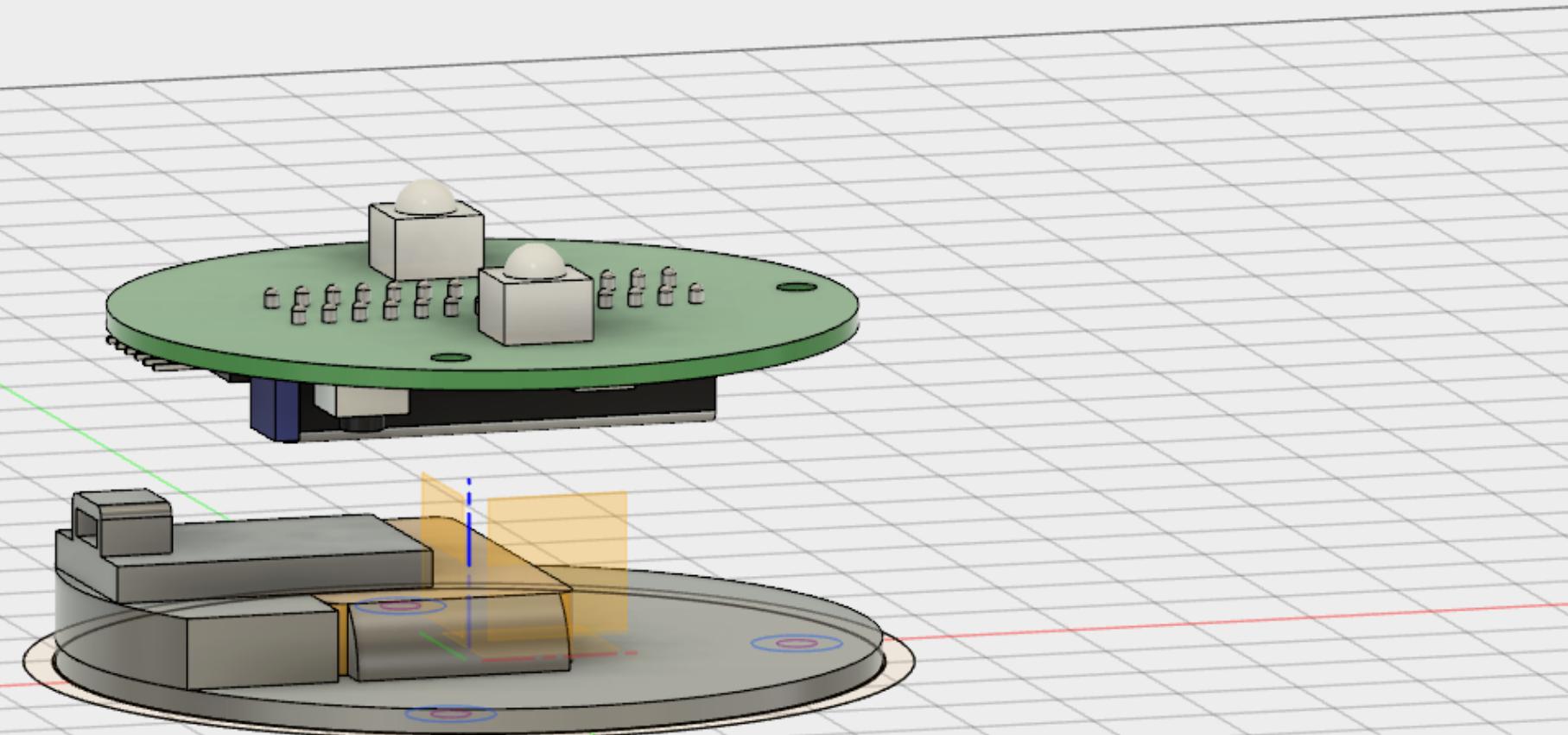
Place the TP4056 Lipo Charger in place



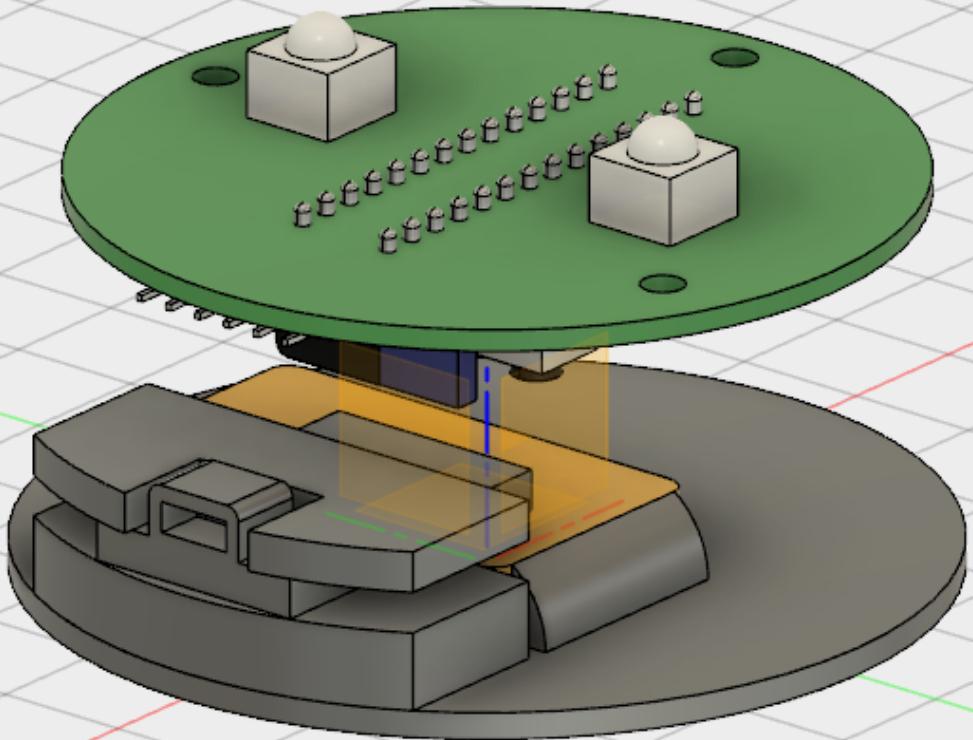
Exture a Battery Locker and apply fillet



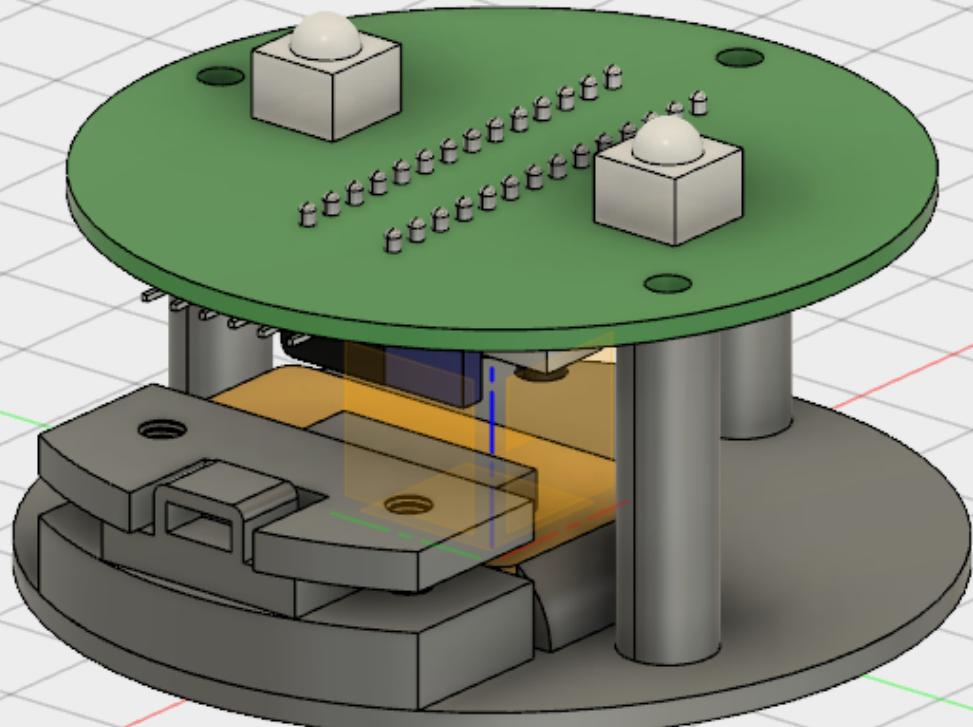
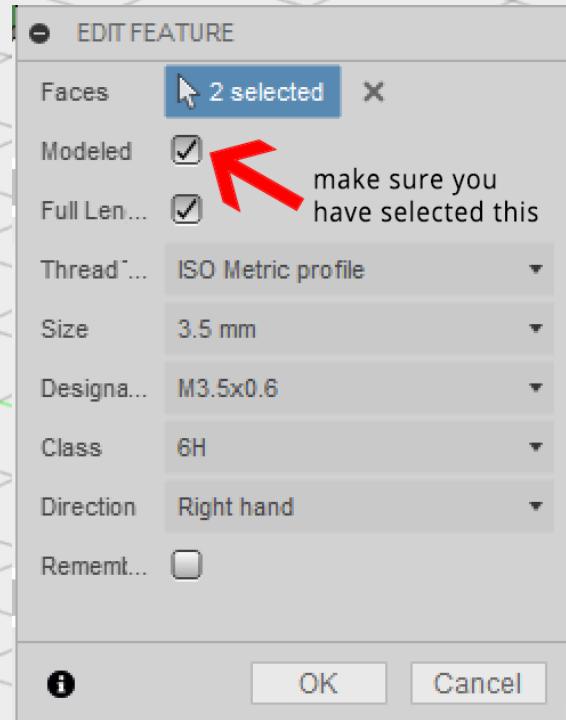
Design a raiser stand for TP4056 Lipo Charger



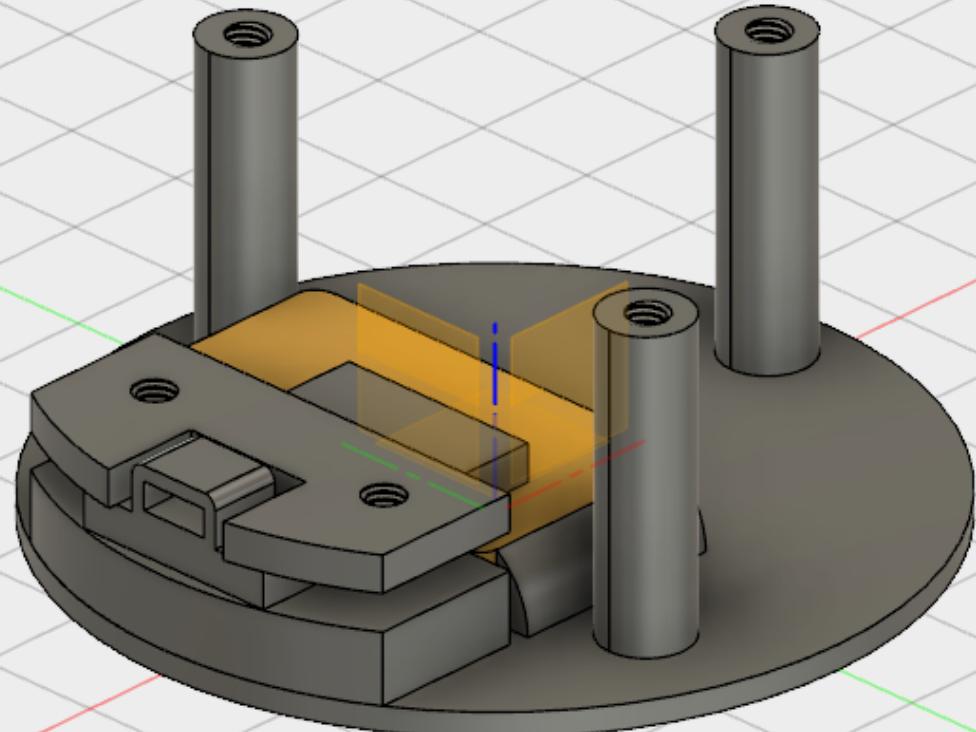
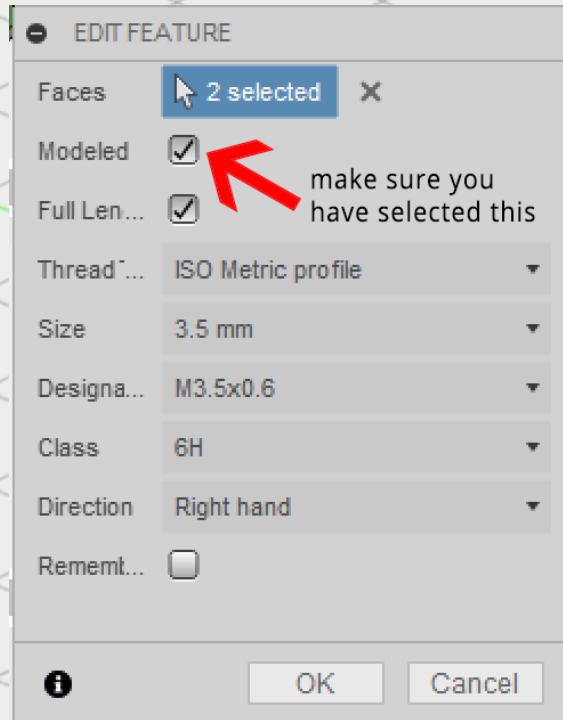
Design an upper locker for TP4056 Lipo Charger



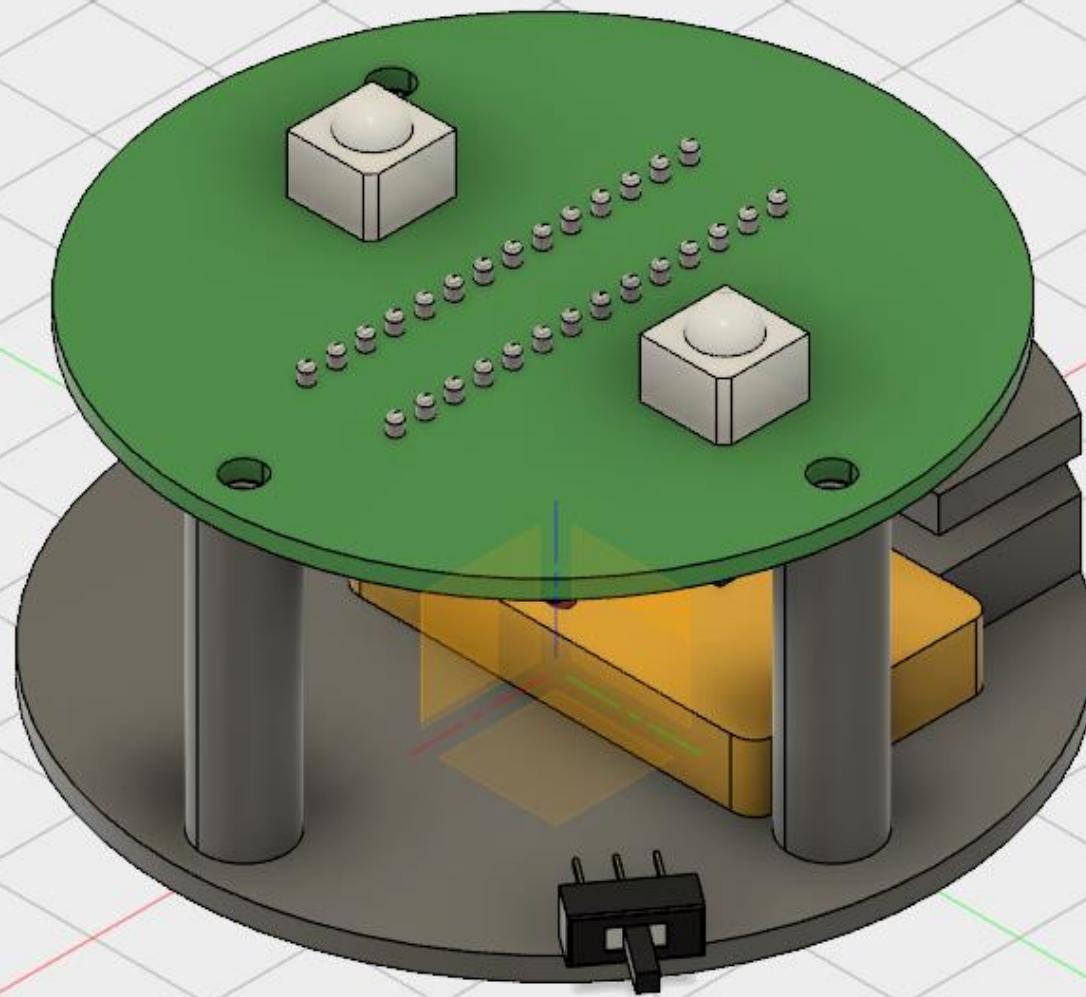
Create holes and establish a thread (3.5mm) on the upper locker



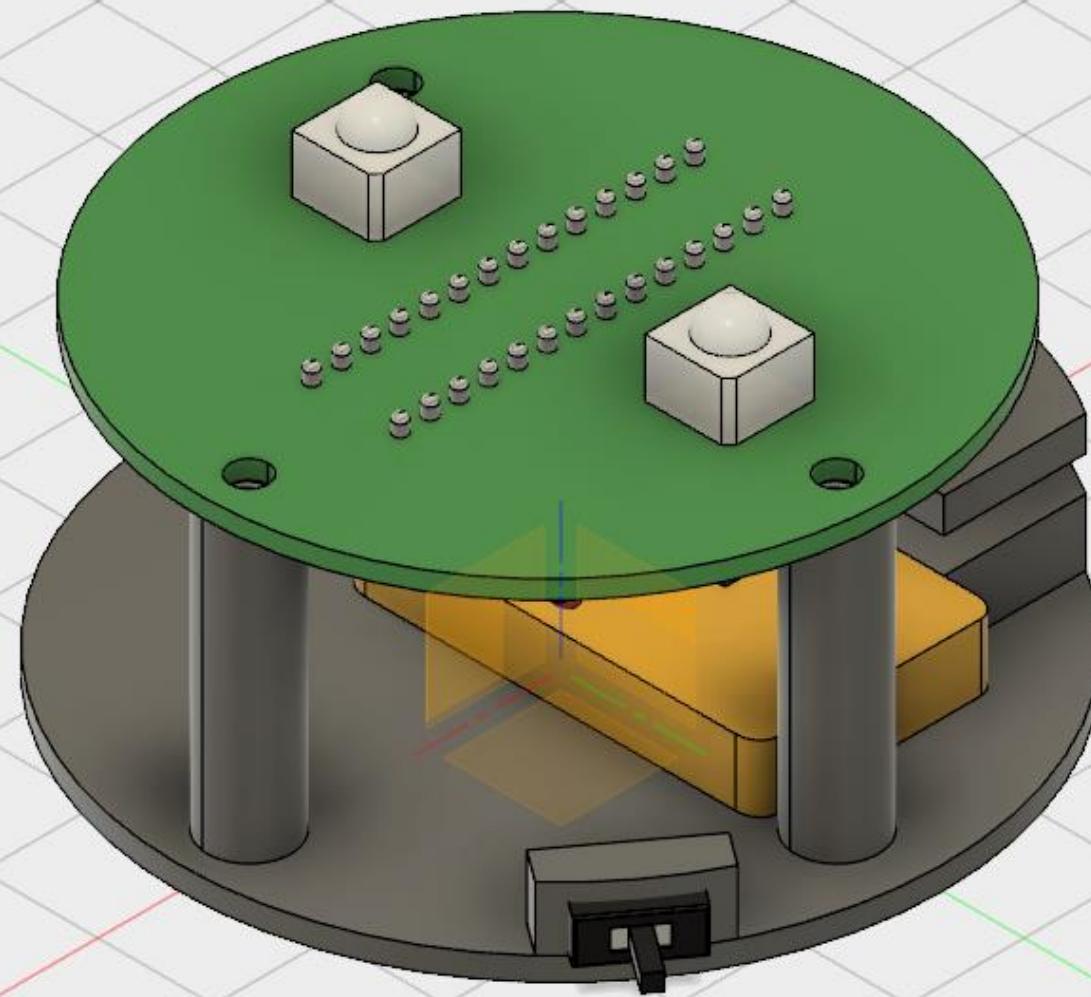
Extrude the three standing legs and prepare threads (3.5 mm) in them



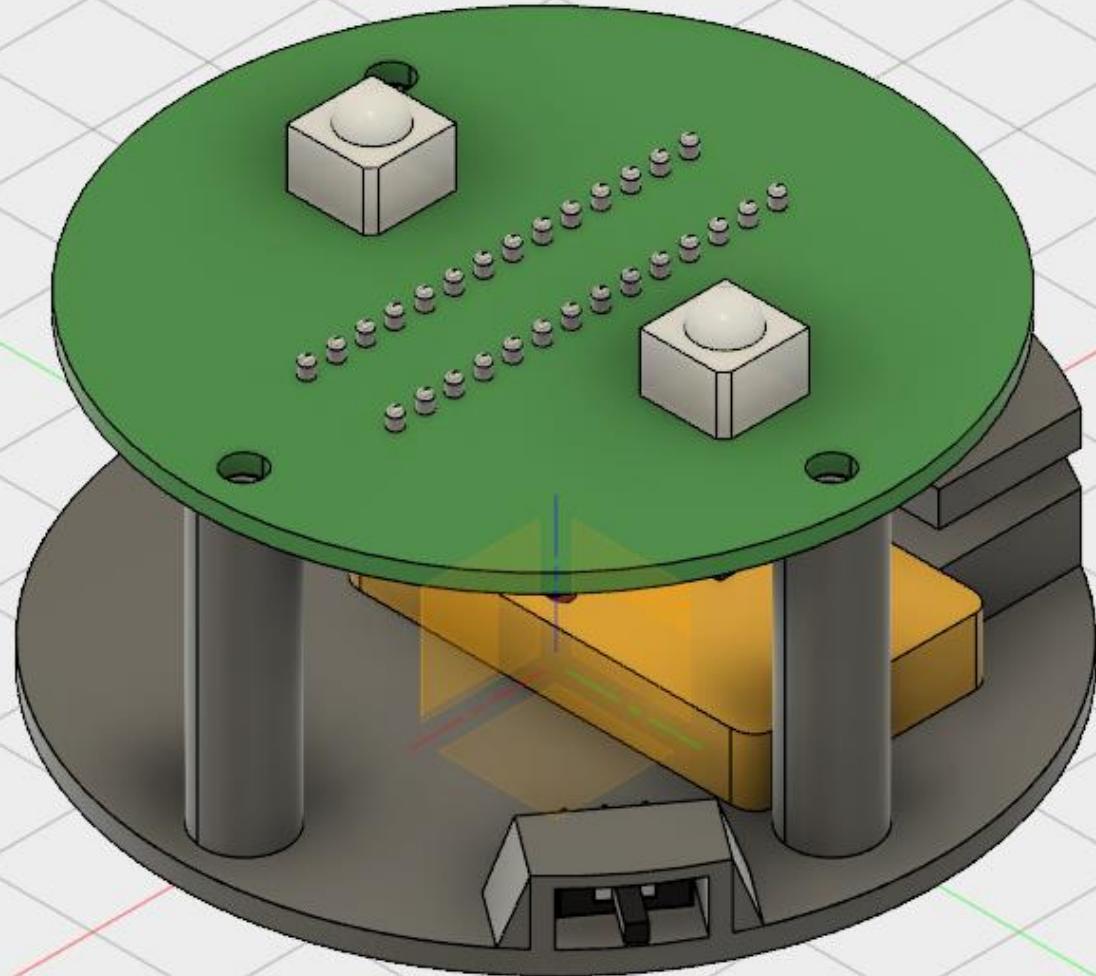
Insert the slide switch and place it accordingly



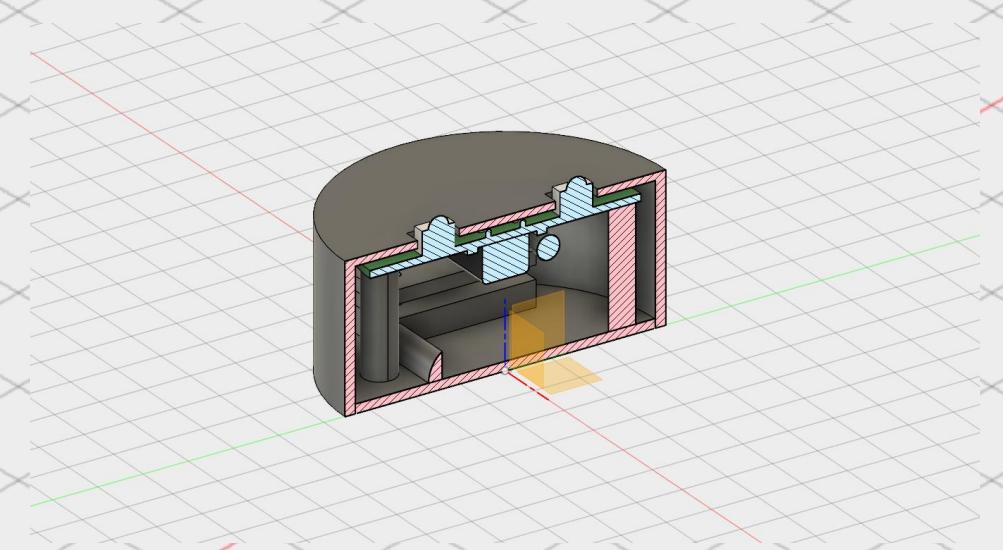
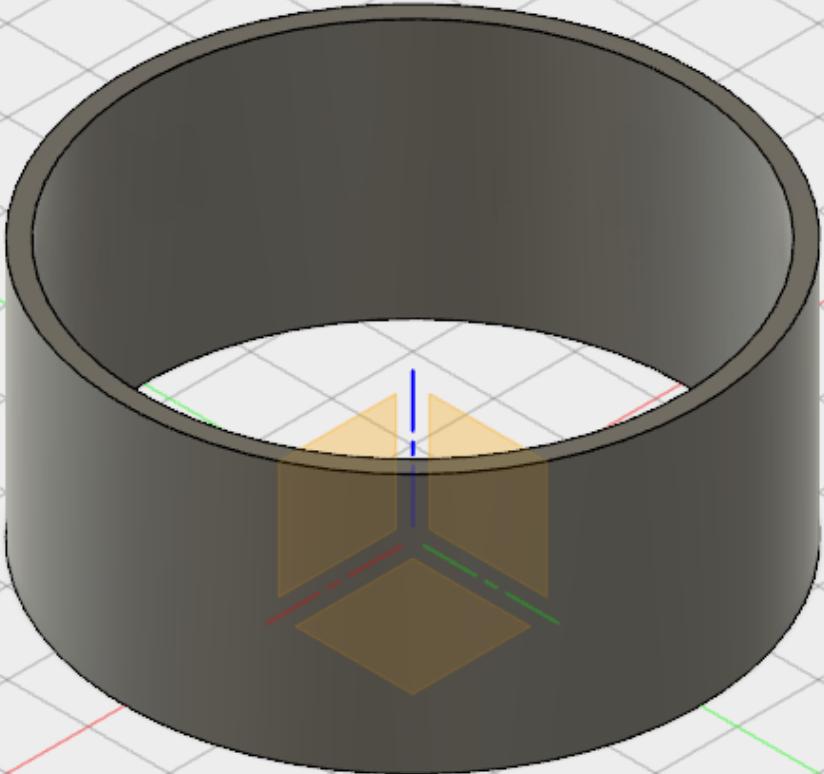
Create a housing for the slide switch



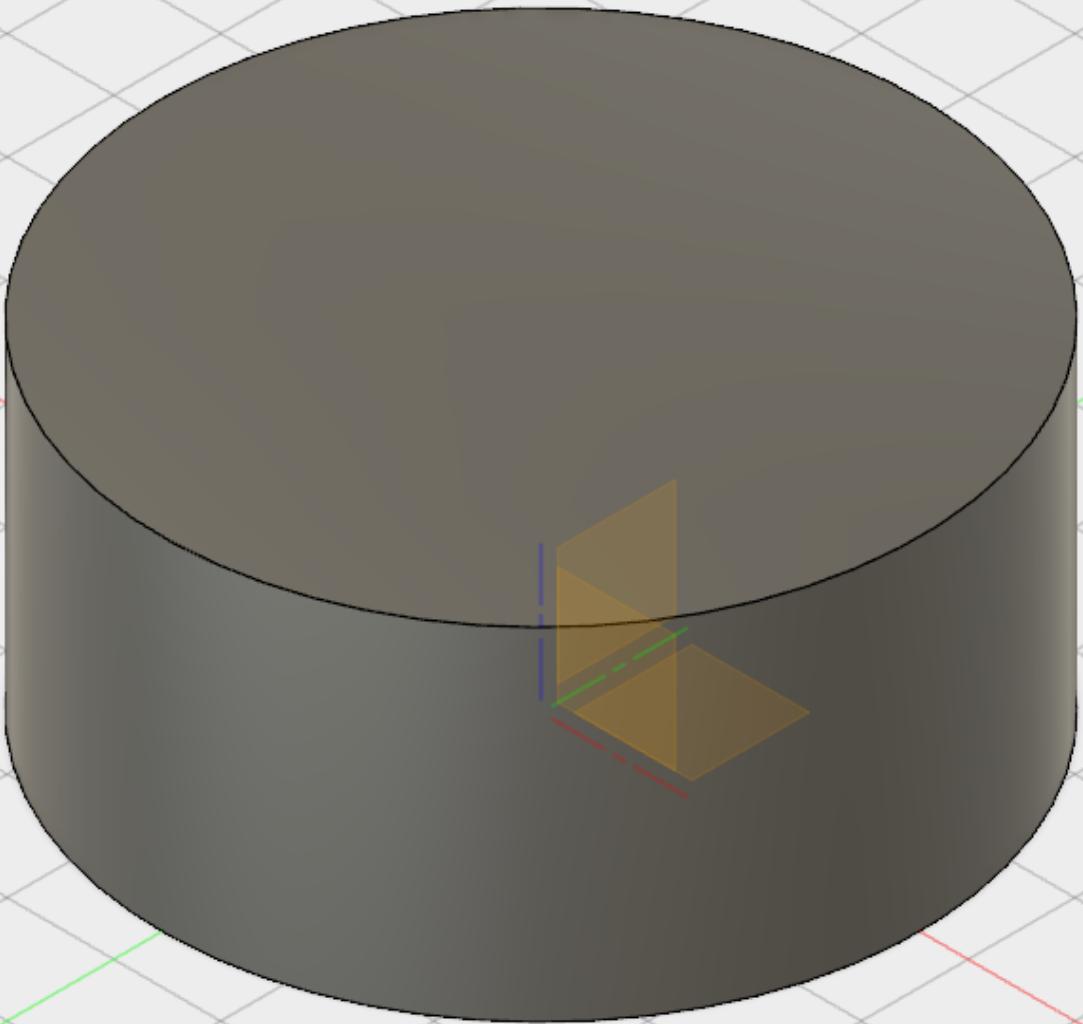
Fine tune housing details



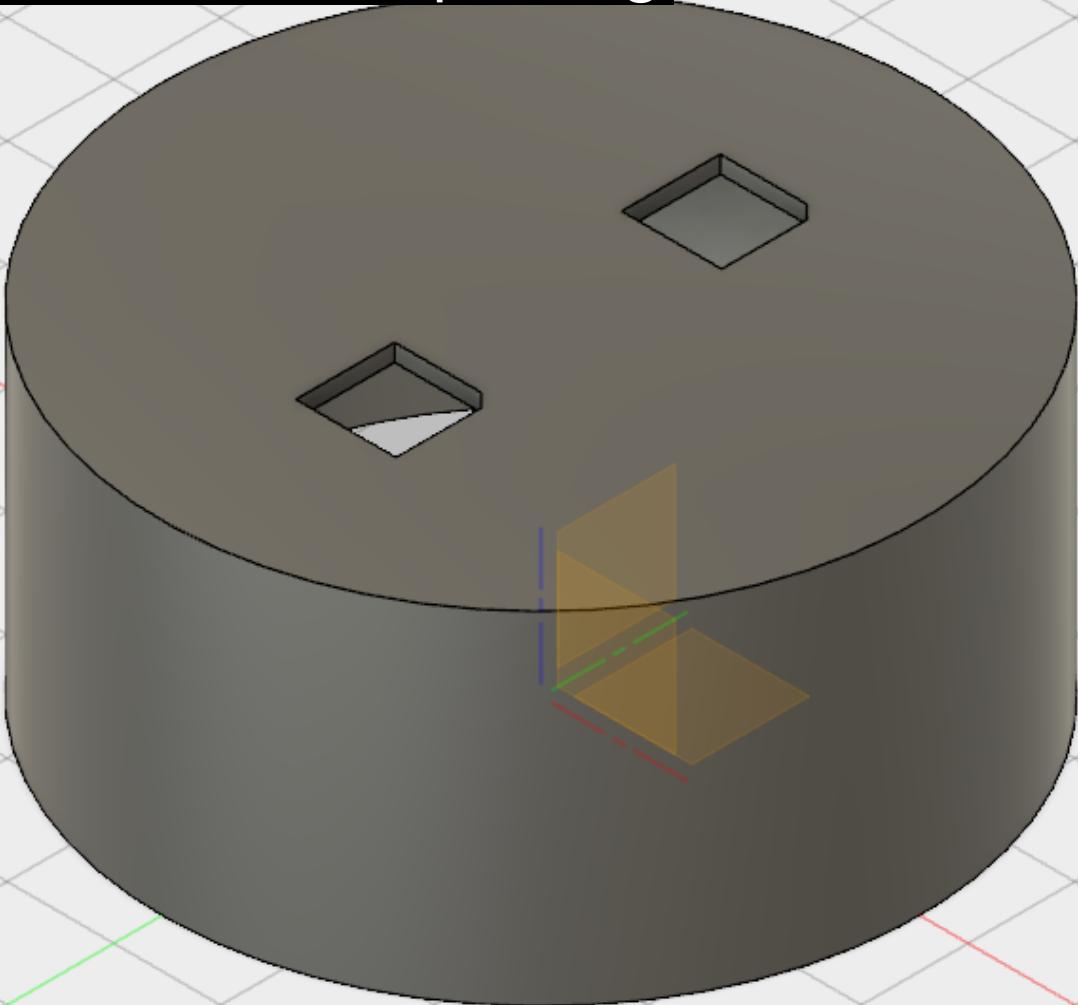
Create a shield for the top enclosure
Apply a section analysis to see the interior



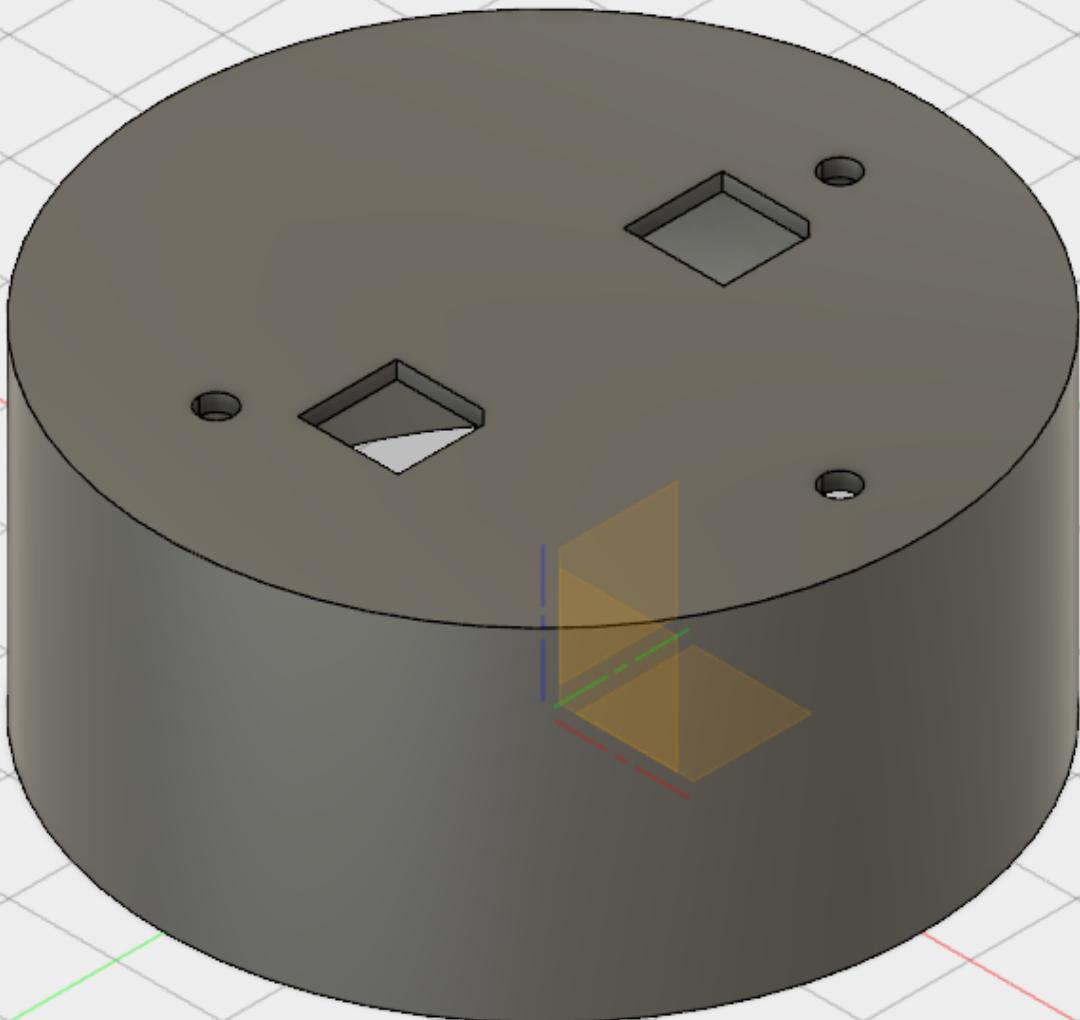
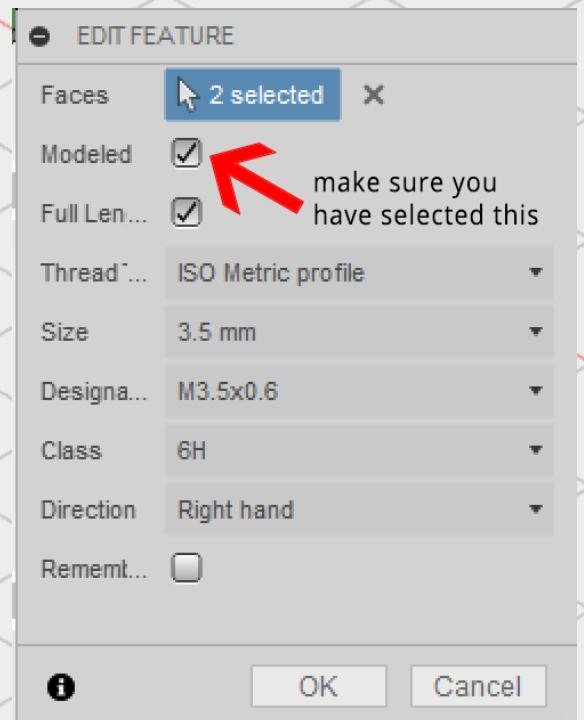
Cover the top



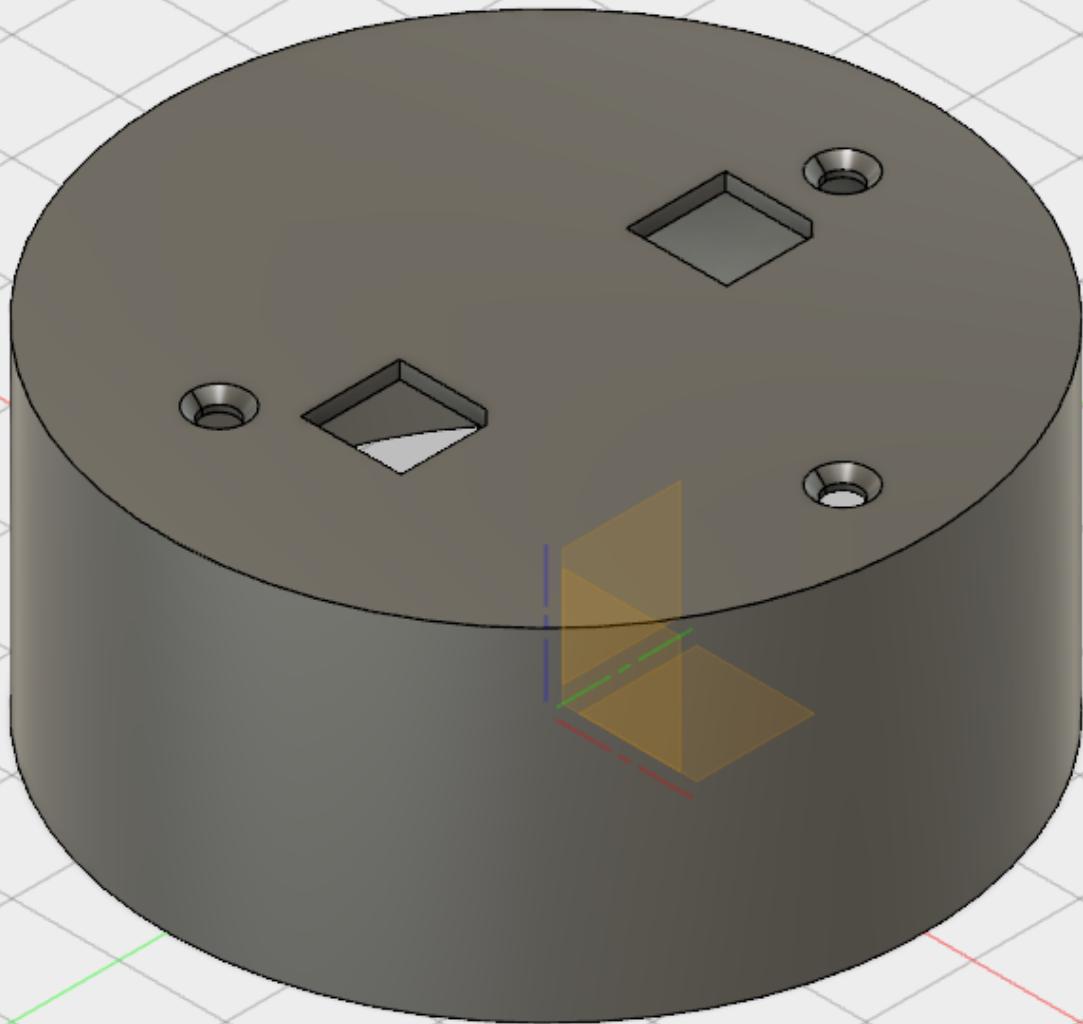
Map the led sketches on to the surface of the top enclosure
Outline 0.5 mm and extrude to cut an opening.



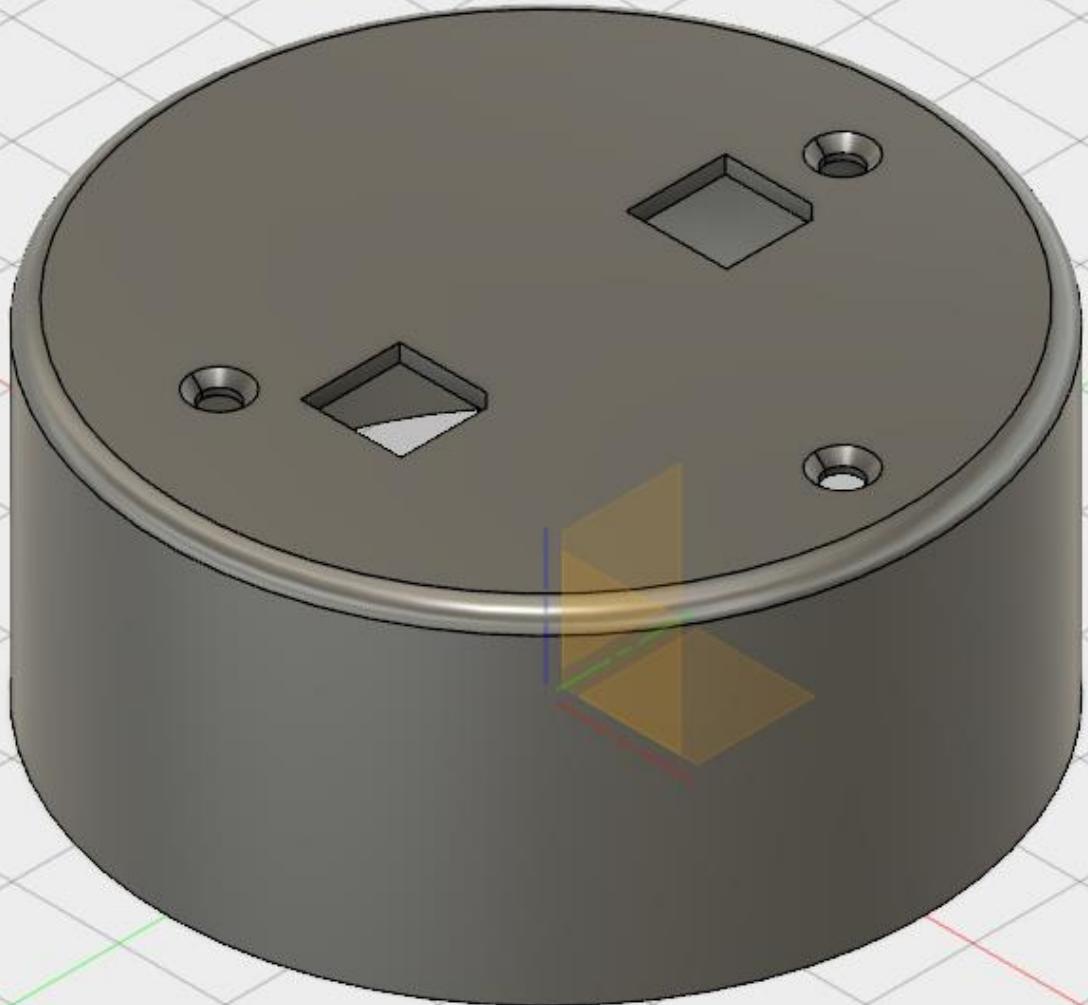
Map the Circuit thread circles and exture to cut holes



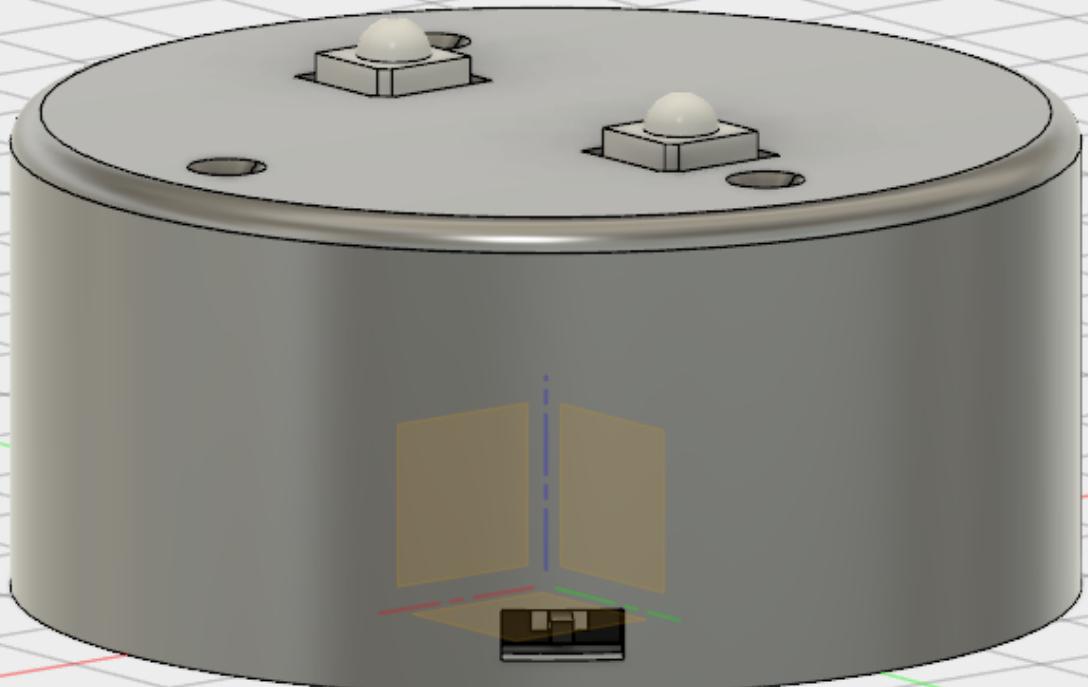
Apply chamfer to let the threads go seemlessly



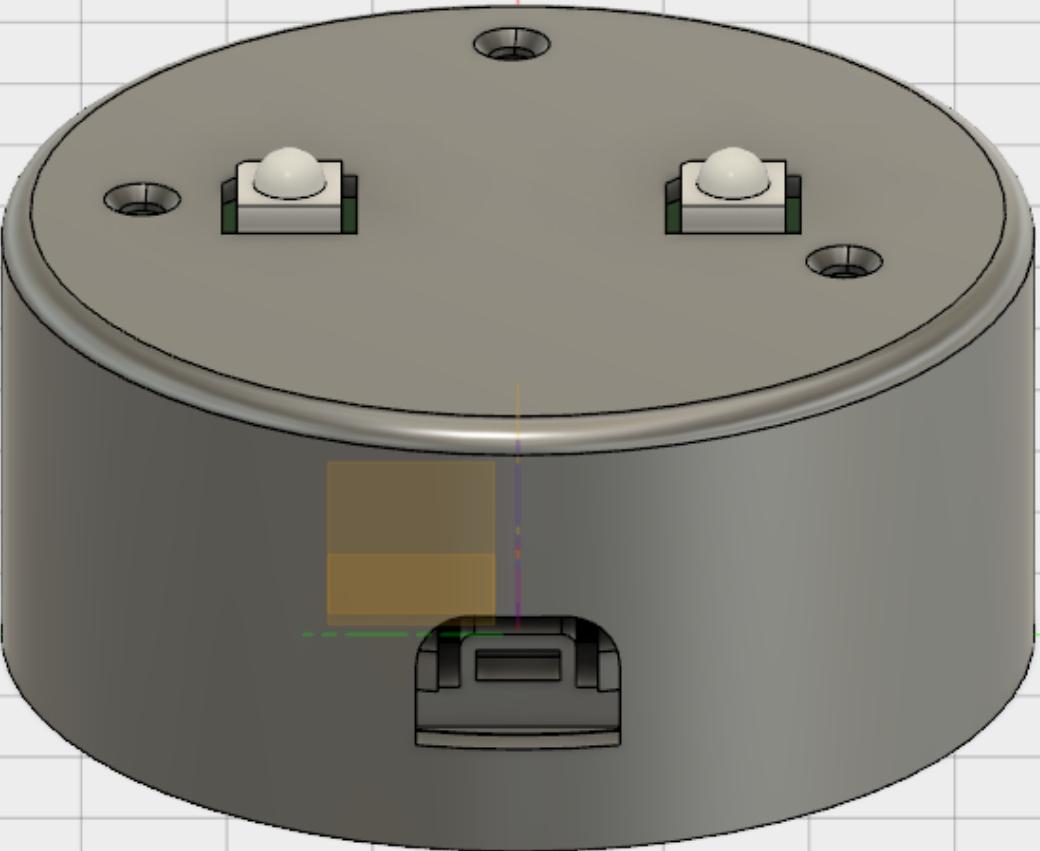
Apply fillet to give the case a soft touch



Create a hole for reaching the slide switch control

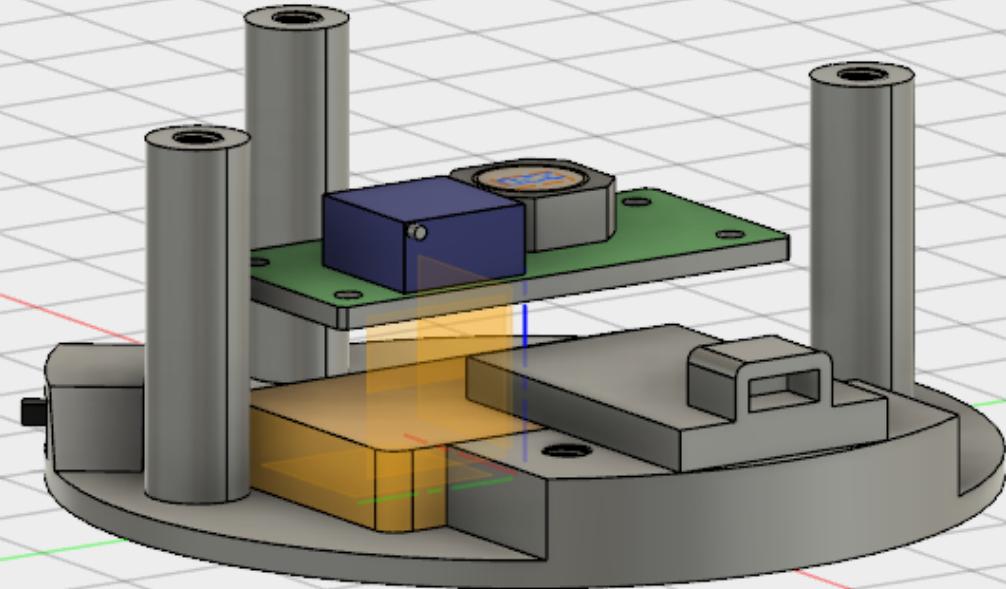


Create a hole for reaching the Lipo Charging USB input powering

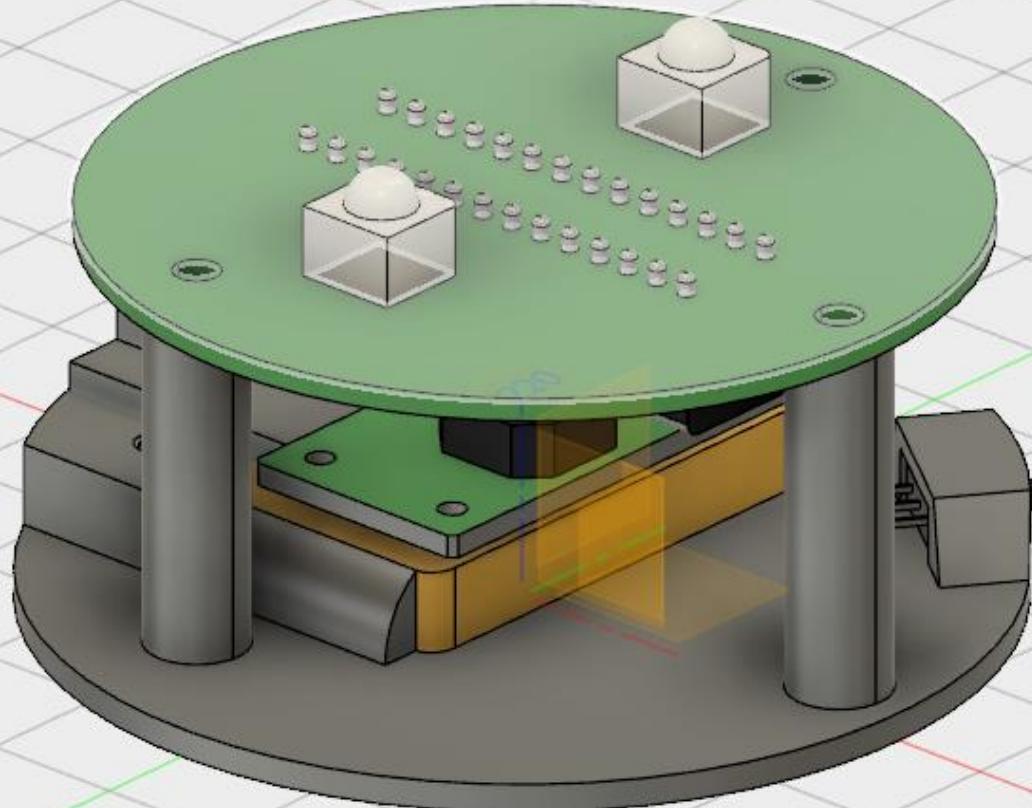


Bring the MT3608 booster to the stage

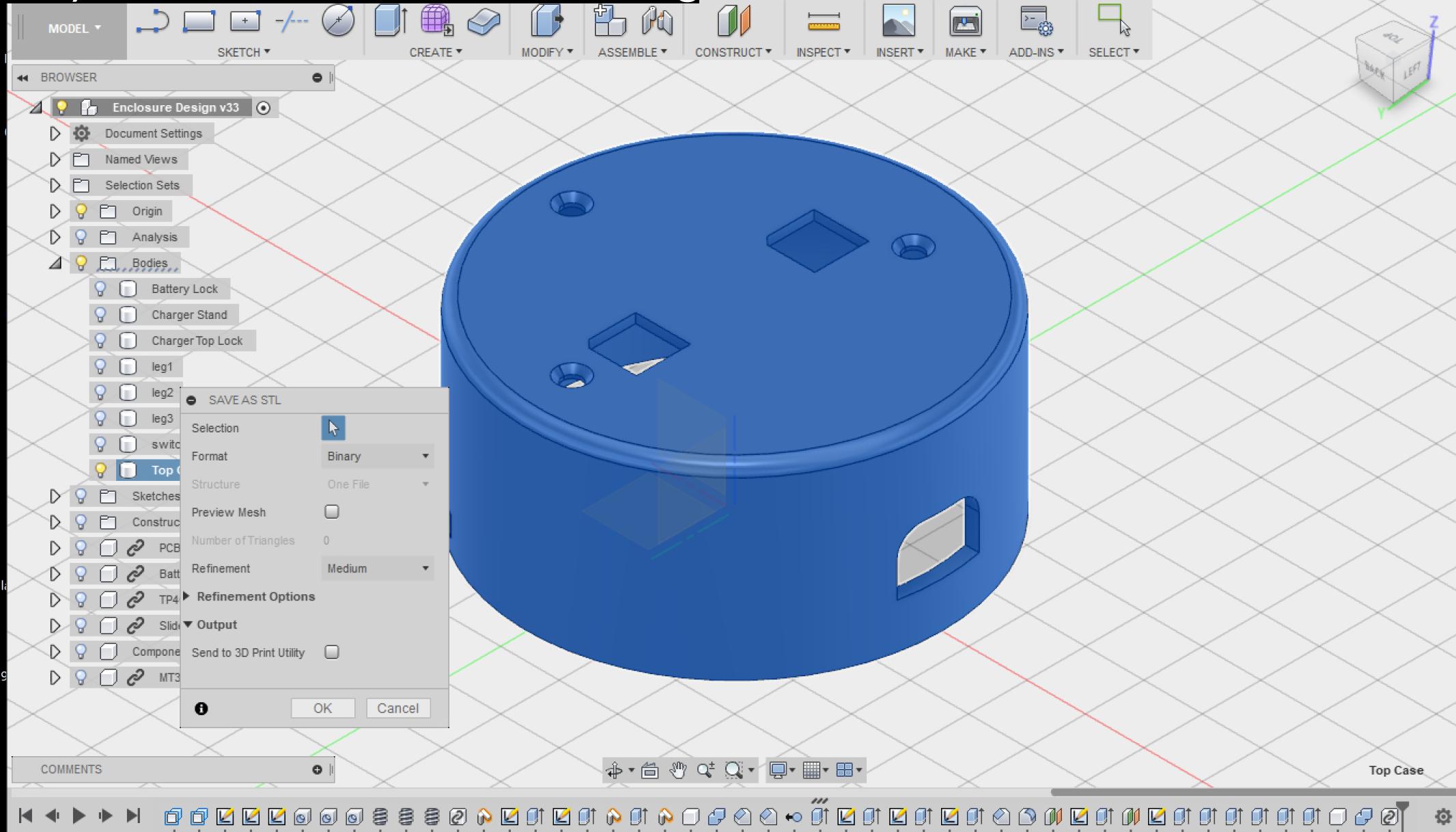
This component will not be attached to any surface at all



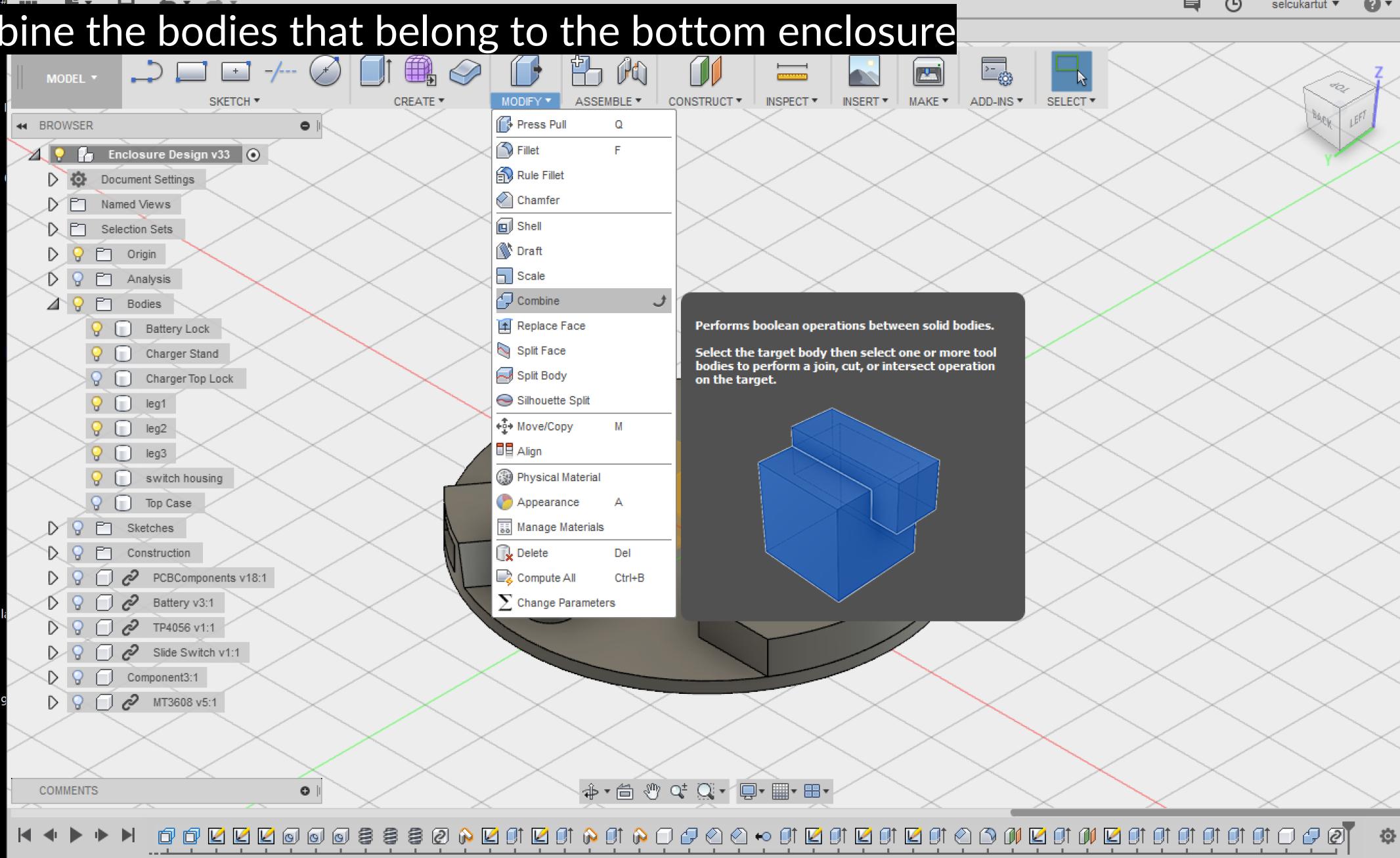
Your design should look something similar to the below



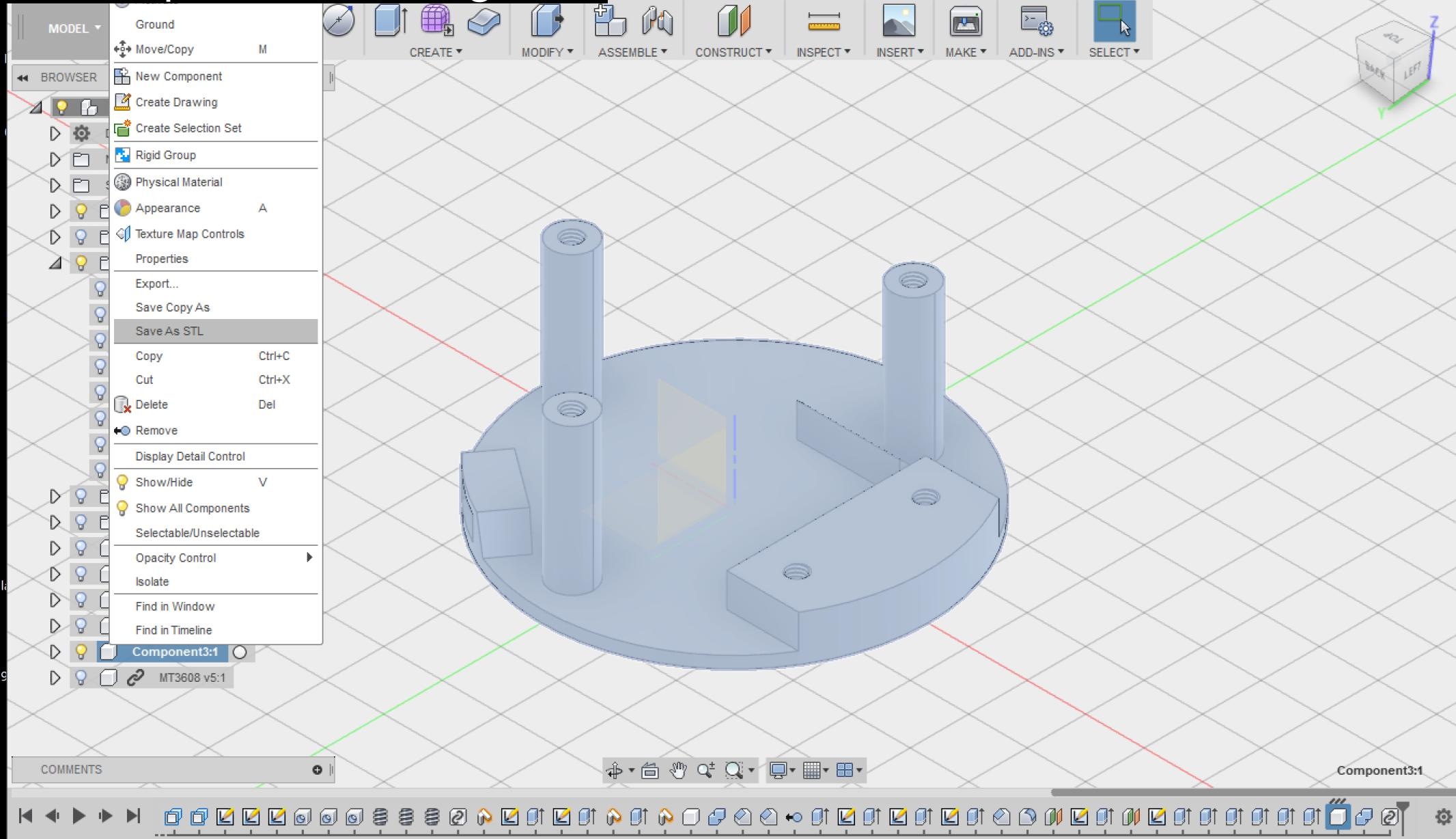
Prepare your STL files for the 3D Printing



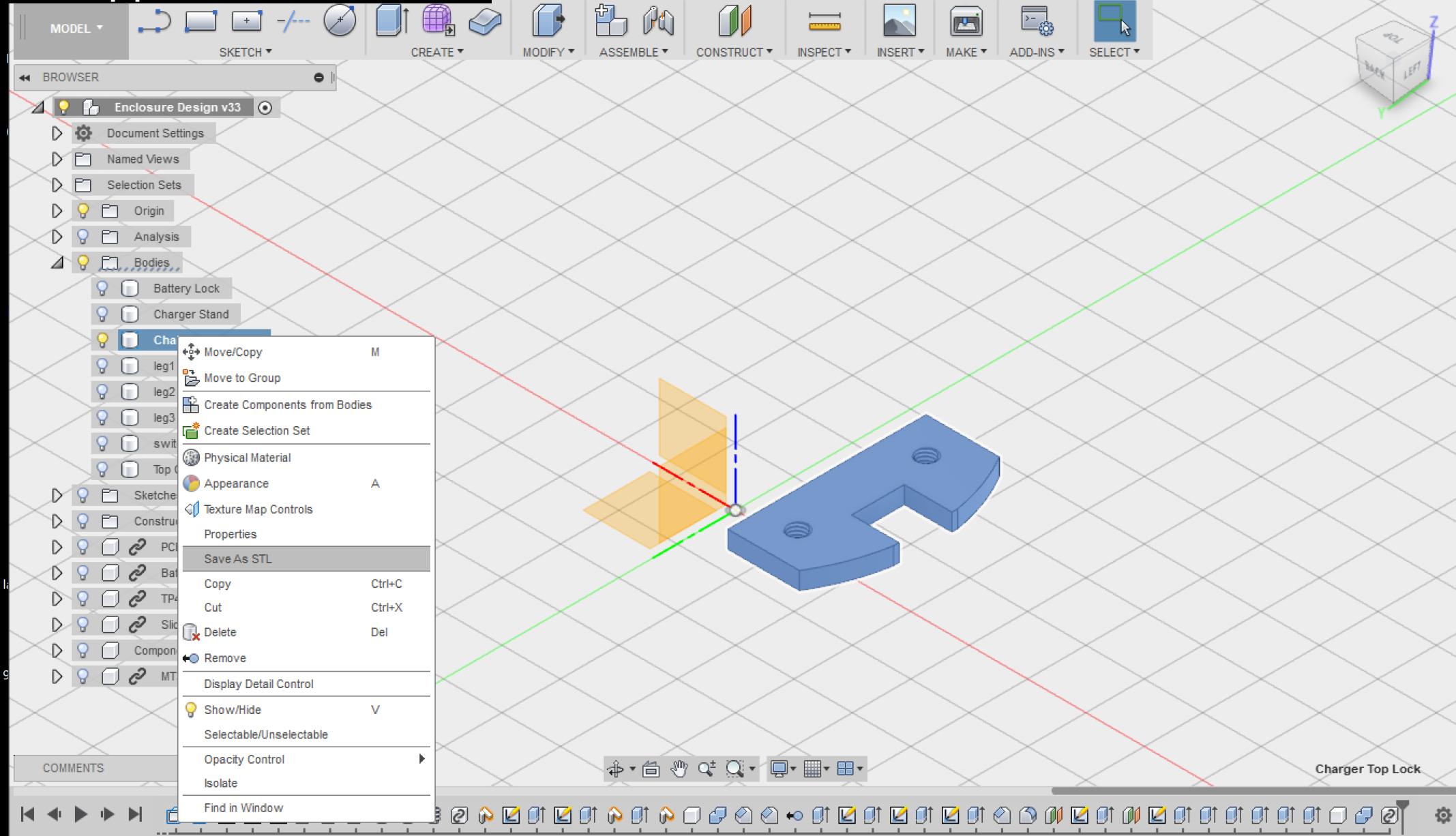
Combine the bodies that belong to the bottom enclosure



Save the components as a single STL



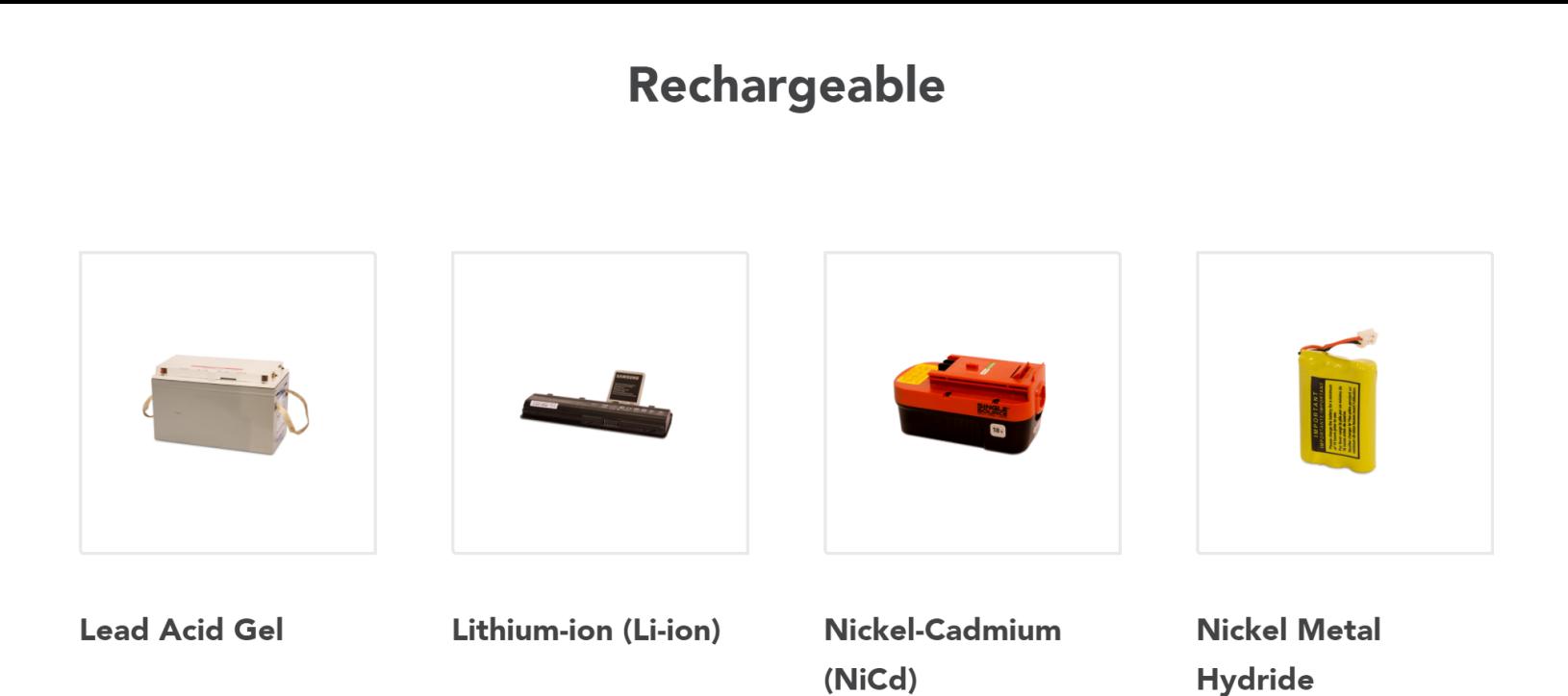
Save the upper locker as a STL



Assemble parts together

Powering Arduino with a Lipo Battery

Battery Types (ref : <https://www.batterysolutions.com/recycling-information/battery-types/>)

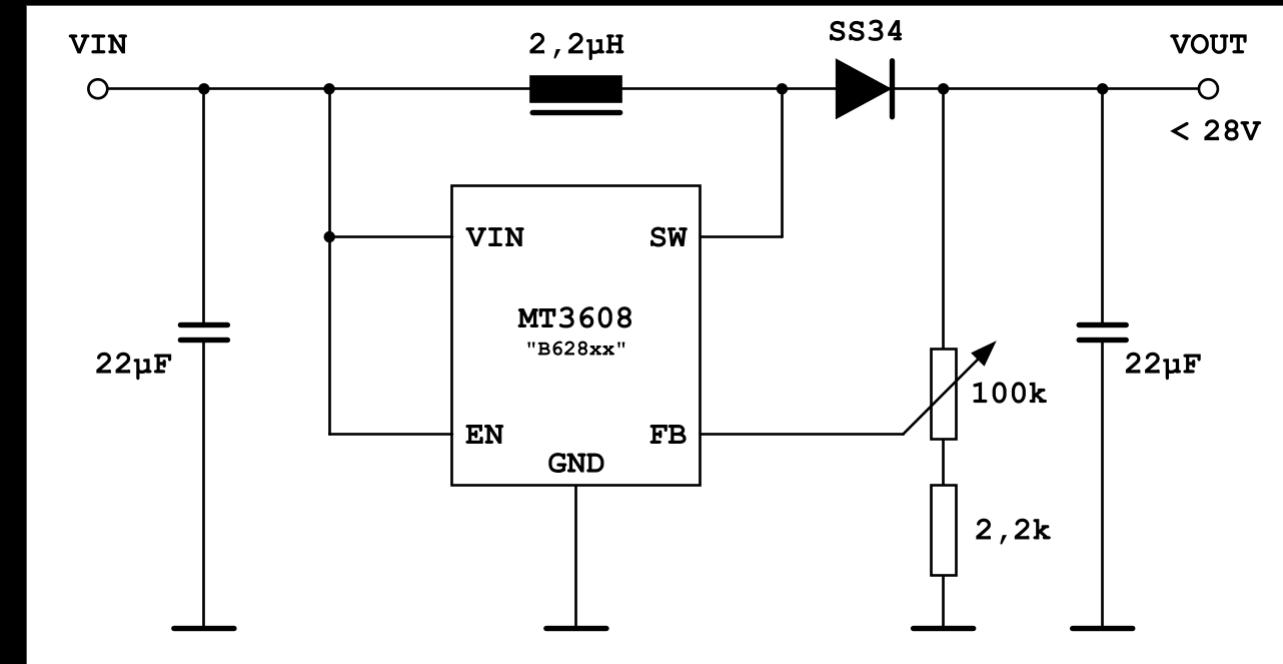
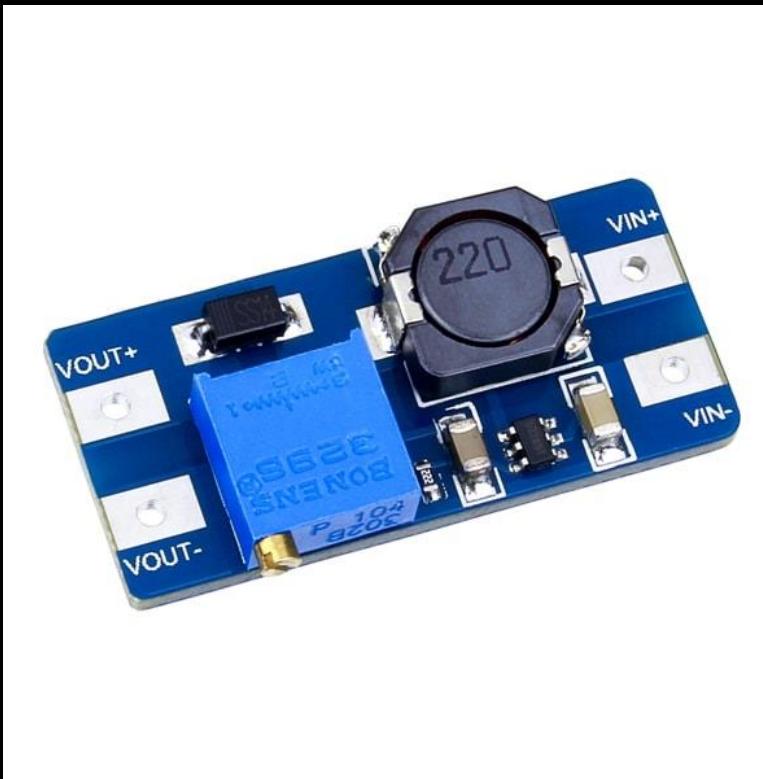


Wiki : A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated as LiPo, LIP, Li-poly, lithium-poly and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid one.

Powering Arduino with a Lipo Battery

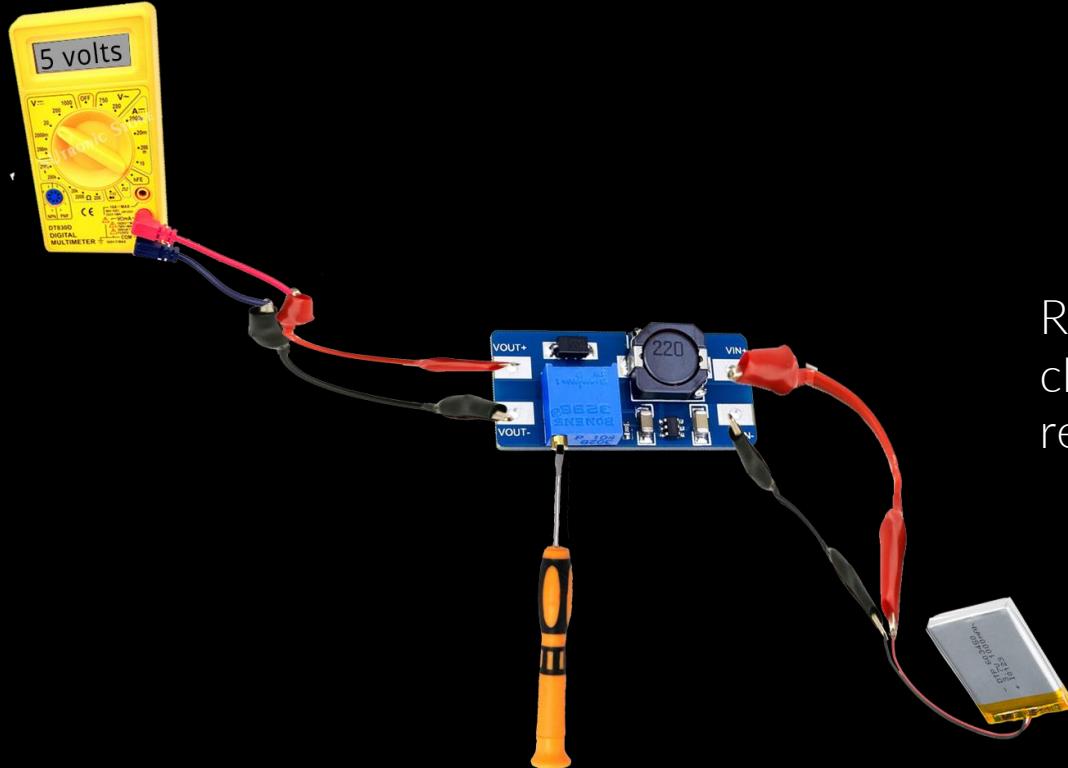
Arduino works with 5Volts – how to boost 3.7 to 5 Volts?

We will use MT3608 - The MT3608 is a constant frequency, 6-pin SOT23 current mode step-up converter intended for small, low power applications. Boost = Output Voltage has to be higher than input voltage



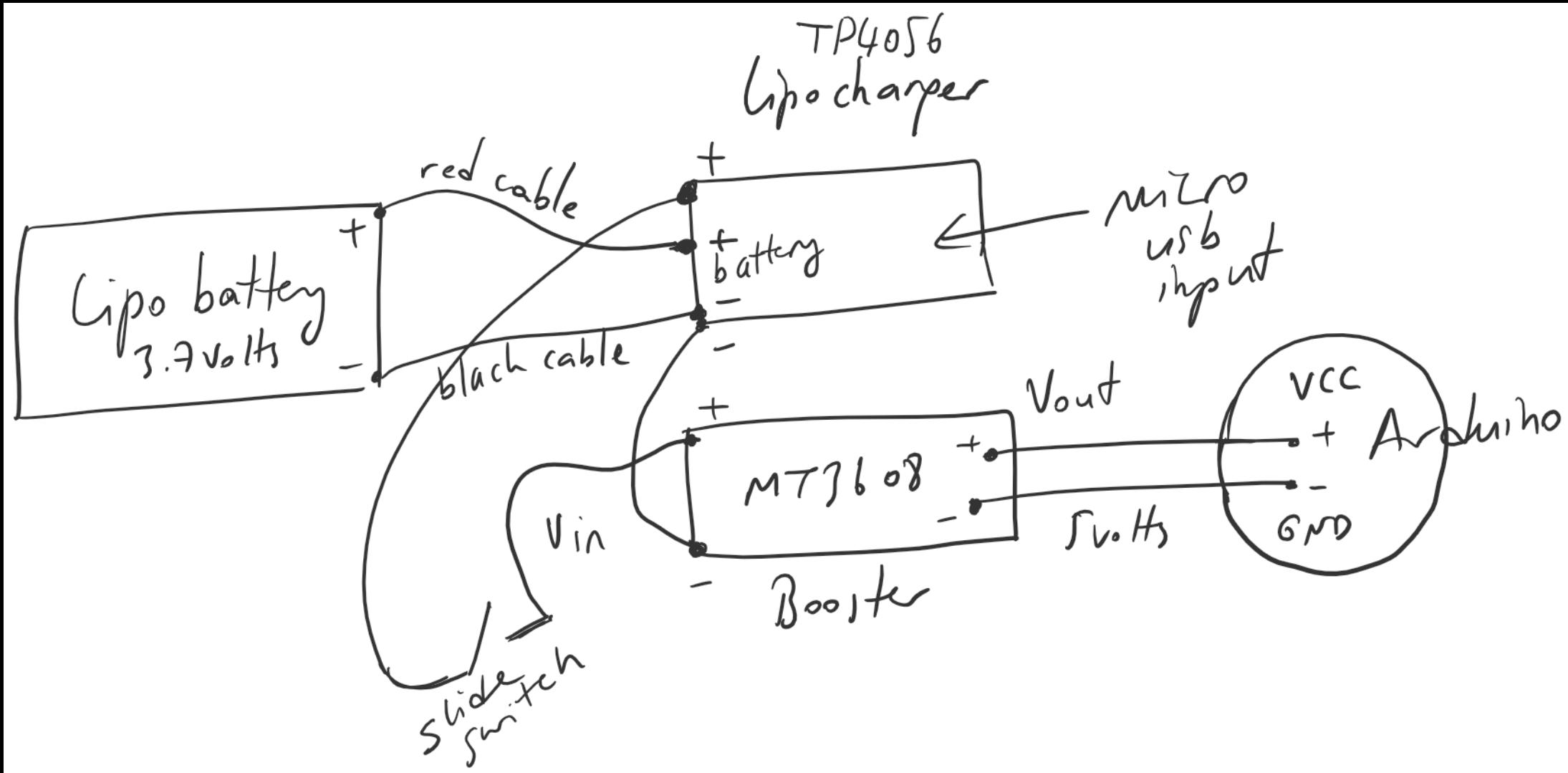
Adjusting the Required 5 volts boosting (Do this before connecting to Arduino)

Equipments required : 4 alligator clips, multimeter, lipo battery, small screwdriver

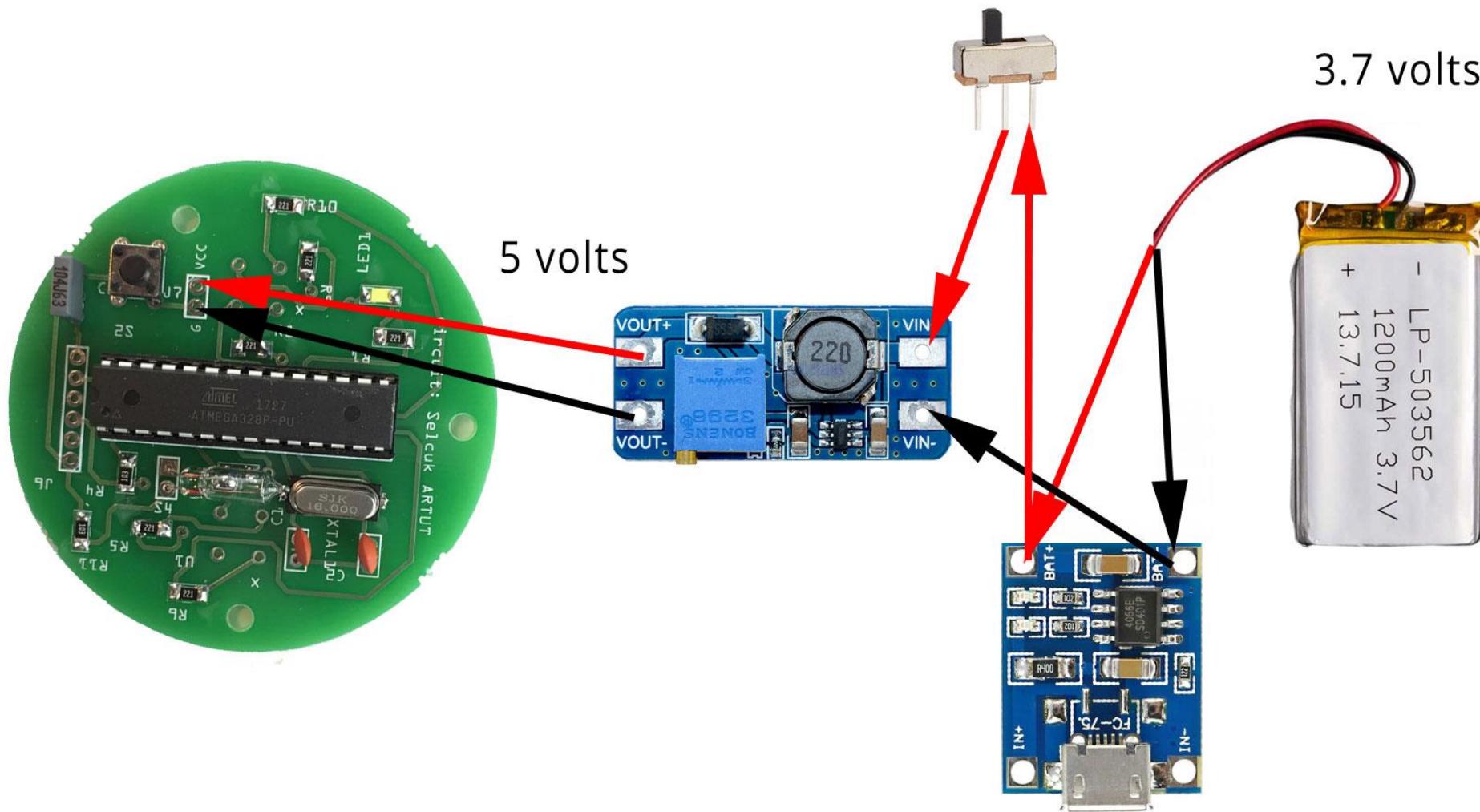


Rotate the small potentiometer until you get a reading close to 5 volts. I recommend you to tune the reading slightly below 5, such as 4.96-97 etc

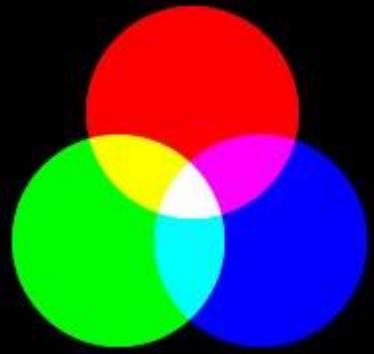
Wiring all parts together



Wiring all parts together



RGB



Code and Testing

- Refer to schematics at Slide 6 for pin mappings
- Be aware that the RGB leds are anode common not cathode common. So `analogWrite(pin, 255)` will turn off the led

Reference: <https://www.hackster.io/tech-duino/using-common-cathode-and-common-anode-rgb-led-with-arduino-7f3aa9>