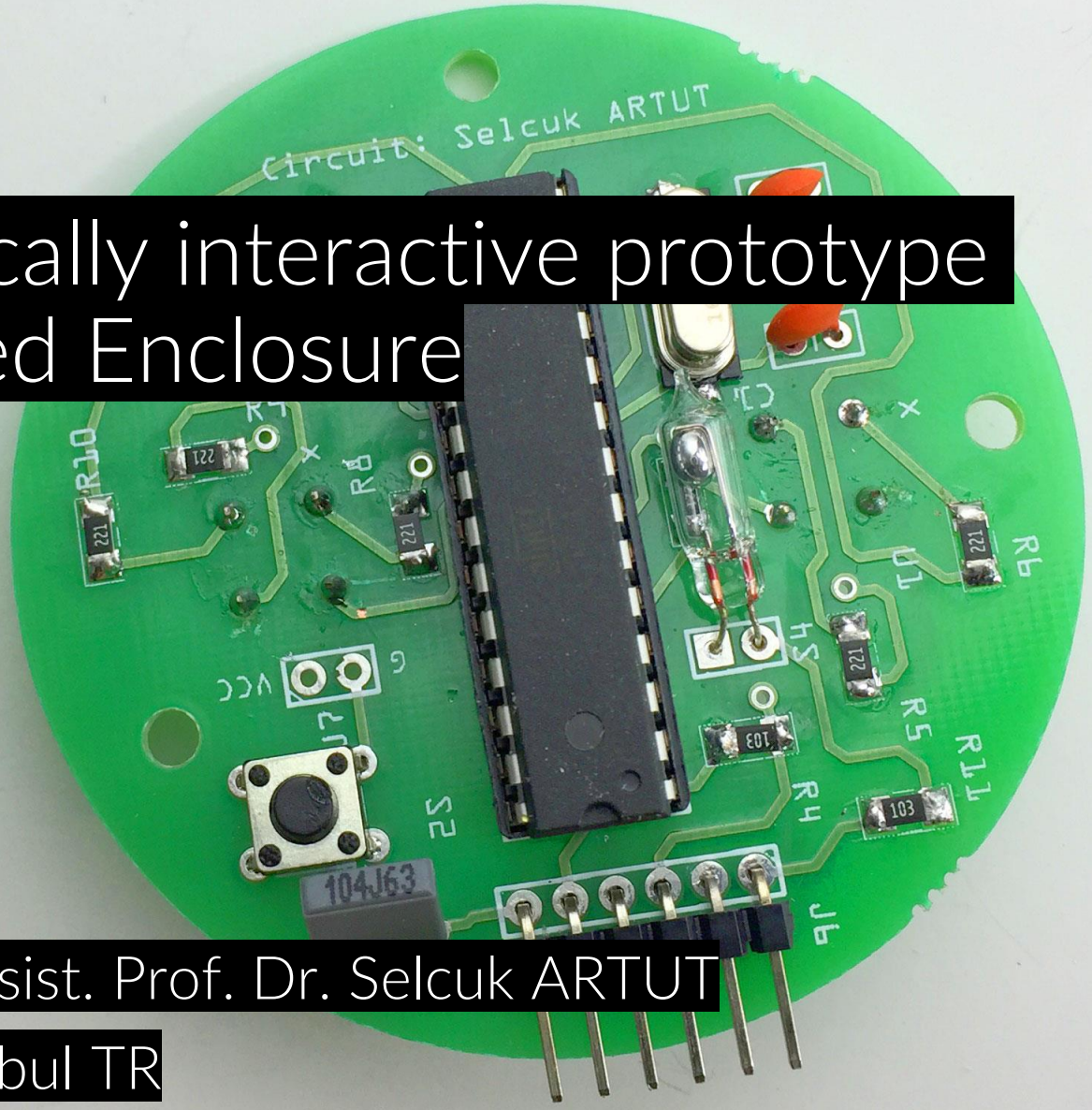
Building a physically interactive prototype with a 3D Printed Enclosure



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

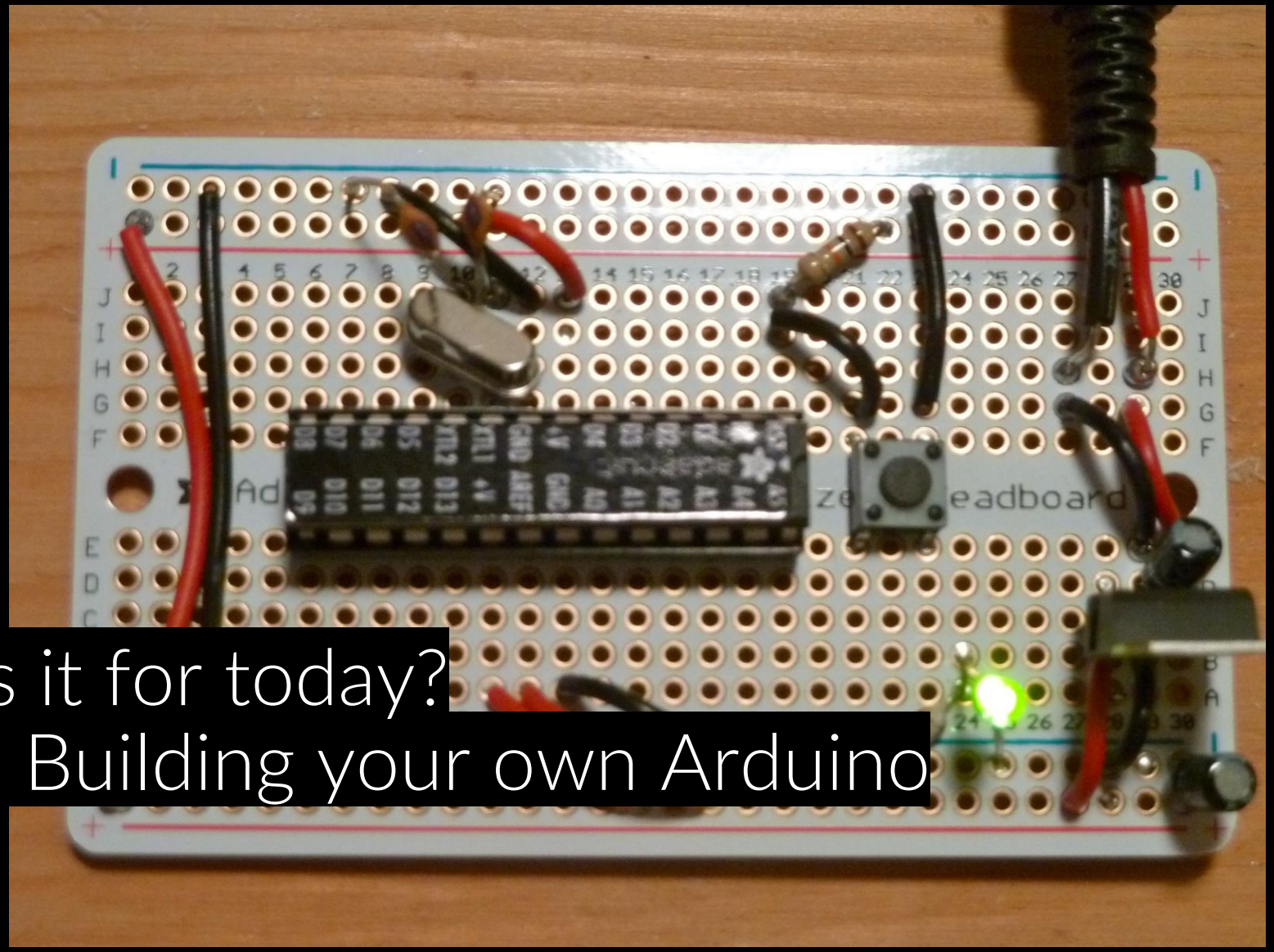
- VA345 Creative Coding
- VA335 Sound and Image
- VA455 Physical Computing
- VA444 Interaction Design
- VA336 Interactive Sound


RAW


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



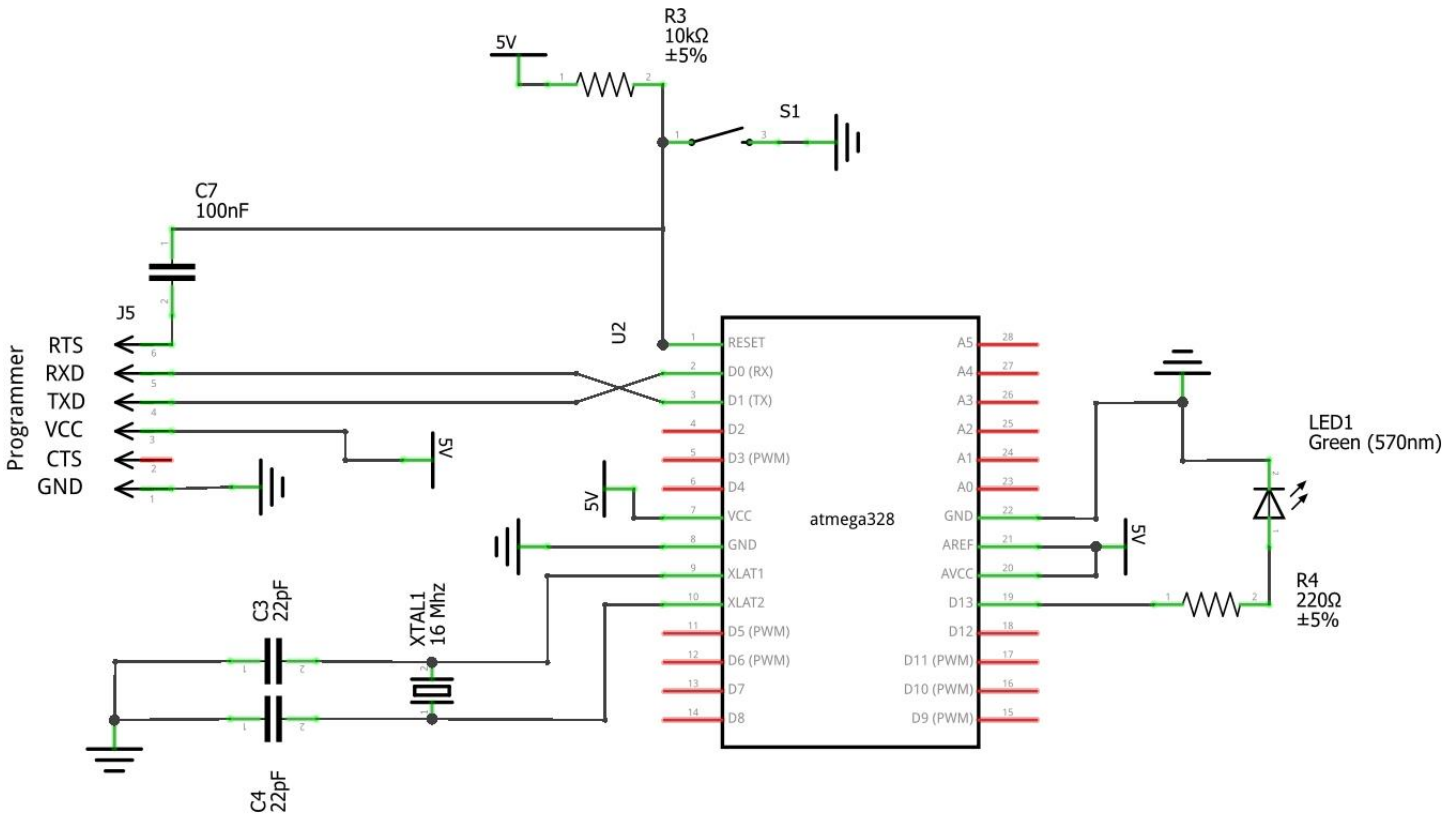
What is it for today?
Part 1 : Building your own Arduino

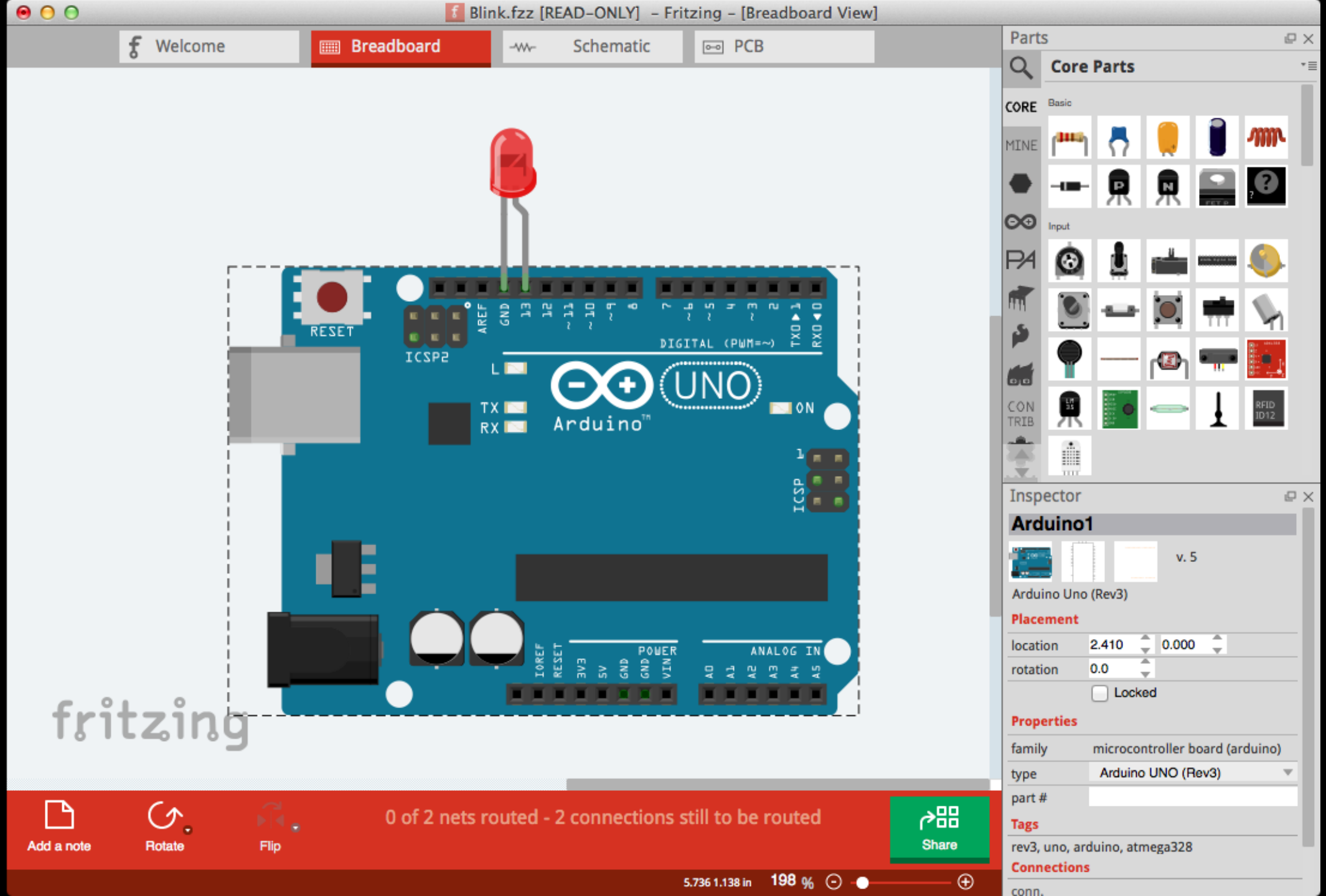
Bootloading an ATMEGA328

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

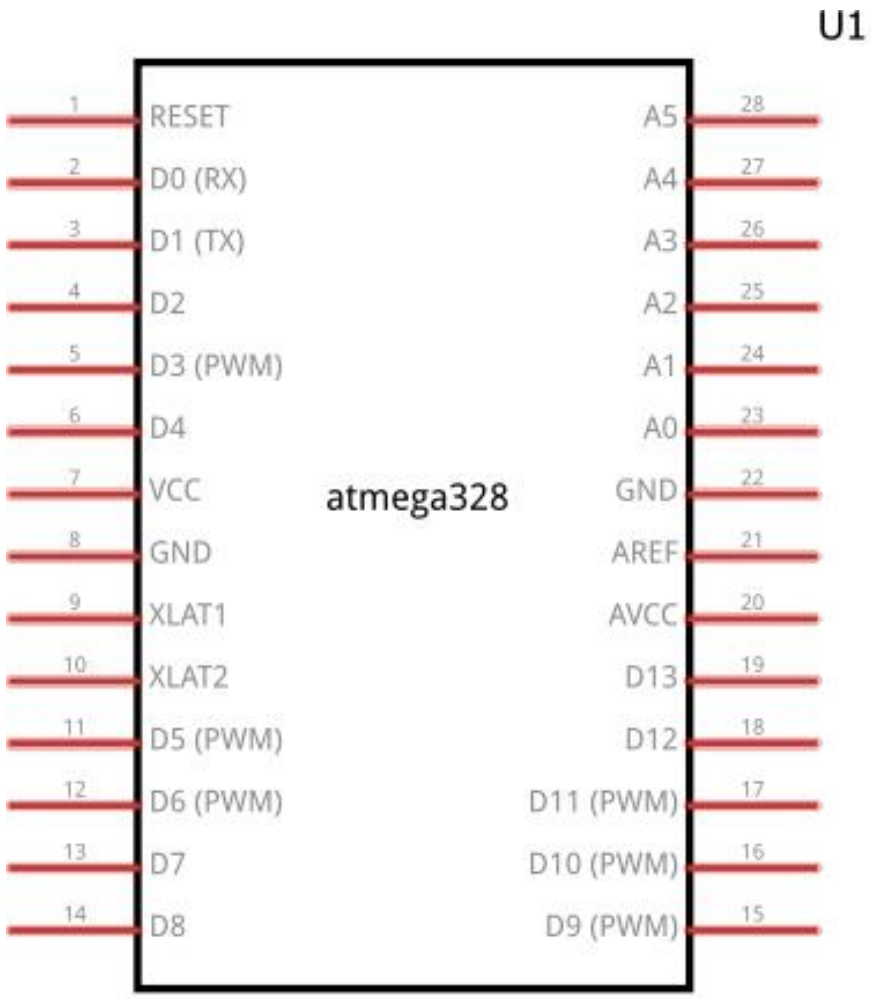
- MISO to MISO
- MOSI to MOSI
- SCK to SCK
- Vcc to Vcc
- Gnd to Gnd
- Reset on target board to D10 on programming board

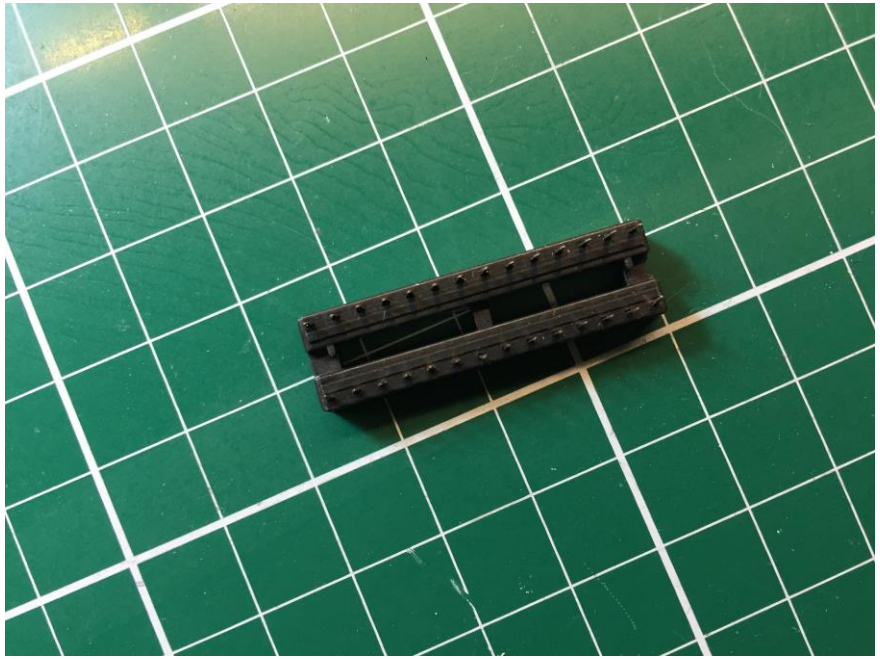
Building your own standalone arduino



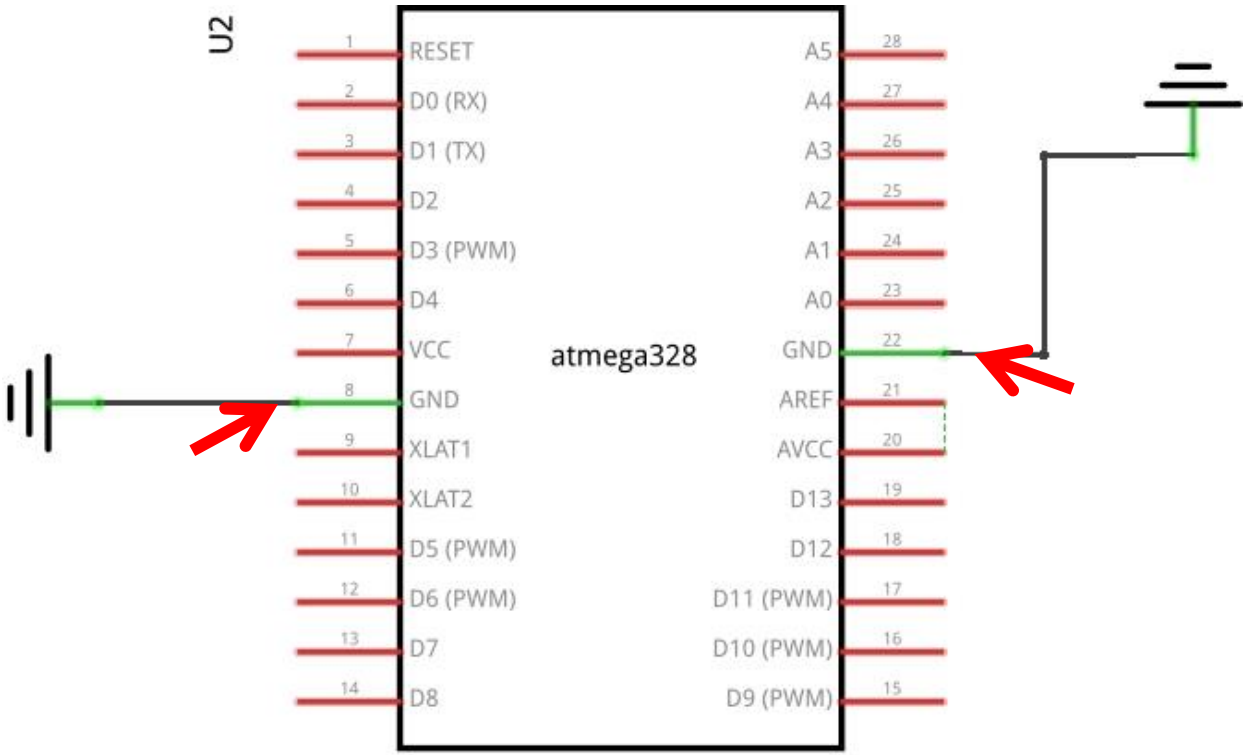

Blink.fzz [READ-ONLY] – Fritzing – [Breadboard View]
Welcome
Breadboard
Schematic
PCB
Parts
Core Parts
CORE
MINE
CON TRIB
Basic
Input
RFID ID12
Inspector
Arduino1
v. 5
Arduino Uno (Rev3)
Placement
location
2.410
0.000
rotation
0.0
Locked
Properties
family
microcontroller board (arduino)
type
Arduino UNO (Rev3)
part #
Tags
rev3, uno, arduino, atmega328
Connections
conn.
RESET
ICSP2
AREF
GND
13
12
11
10
9
8
7
6
5
4
3
2
TX→1
RX←0
DIGITAL (PWM=~)
L
TX
RX
UNO
Arduino™
ON
ICSP
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
fritzing
Add a note
Rotate
Flip
0 of 2 nets routed - 2 connections still to be routed
Share
5.736 1.138 in
198 %

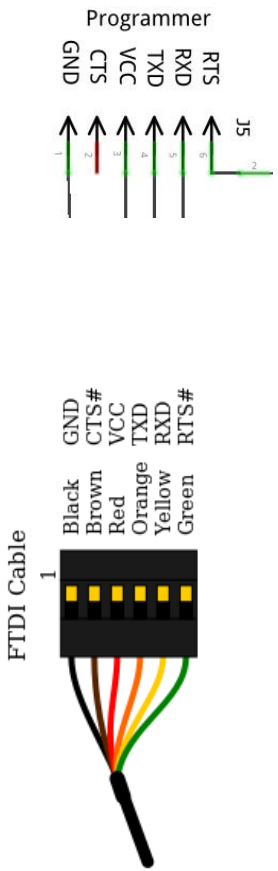
Building your own standalone arduino
Step 1 – Place your ATMEGA328 IC





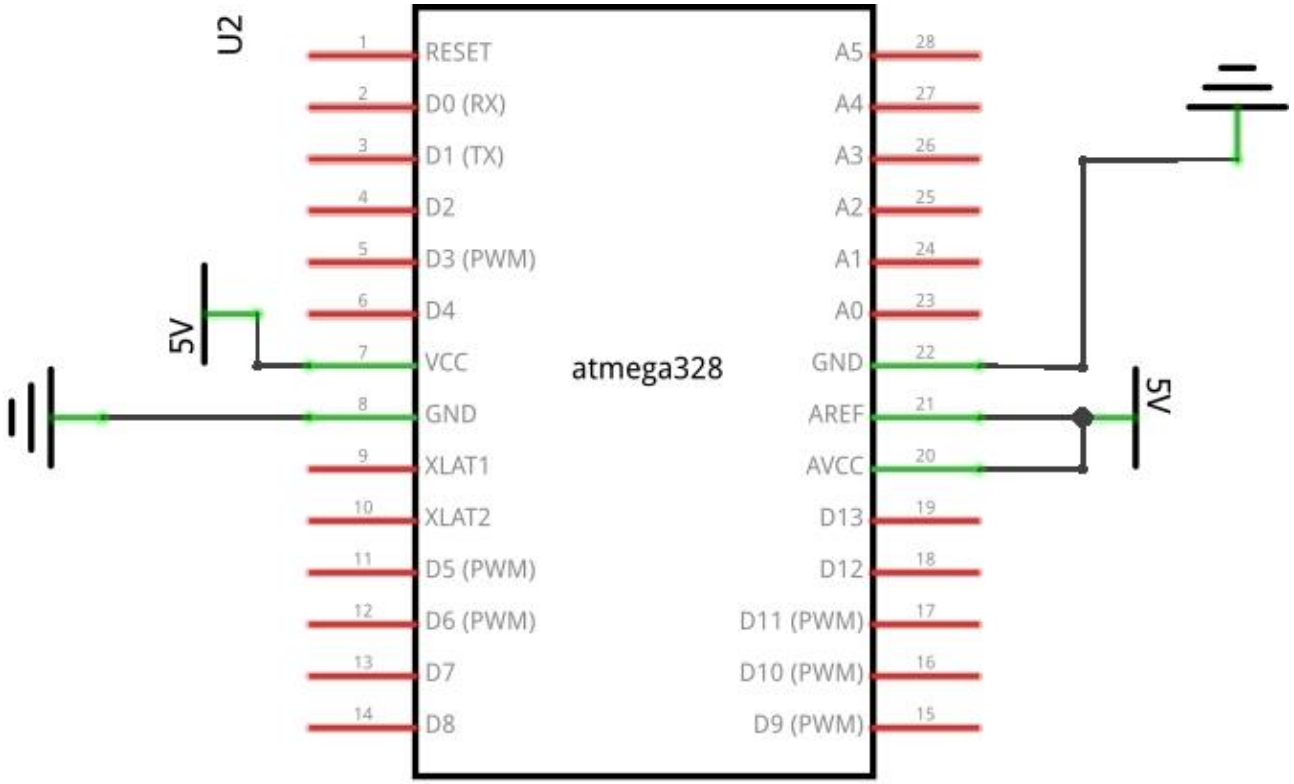
Building your own standalone arduino
Step 2 – Wire Ground Connections for IC

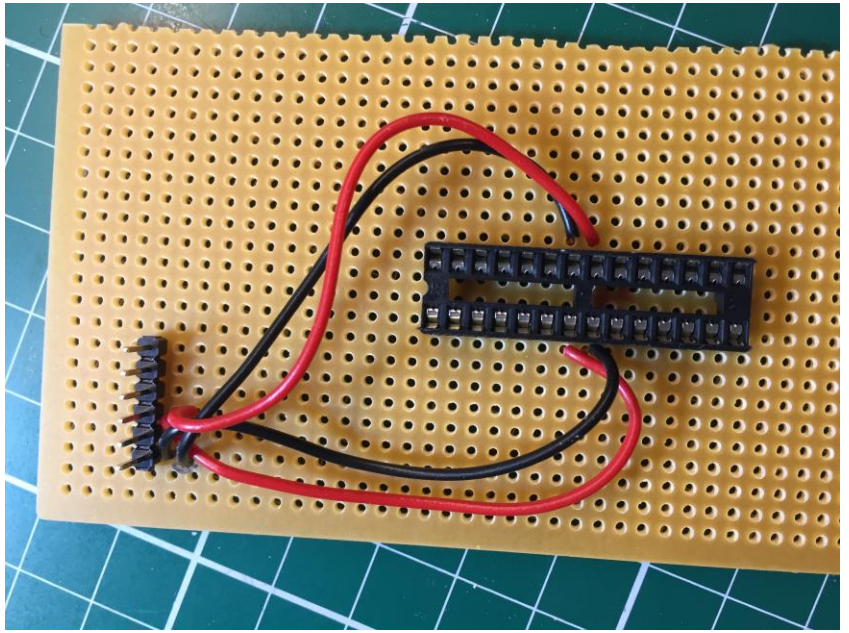


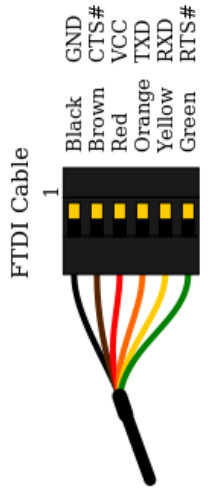


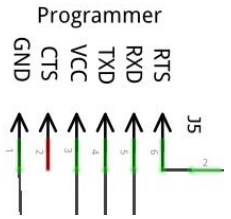
Use Black for Ground
Red for VCC Connections

Building your own standalone arduino
Step 3 – Wire VCC (5v) Connections for IC

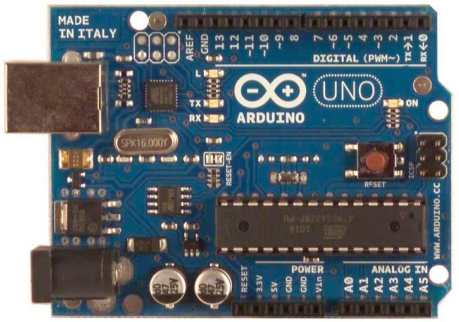


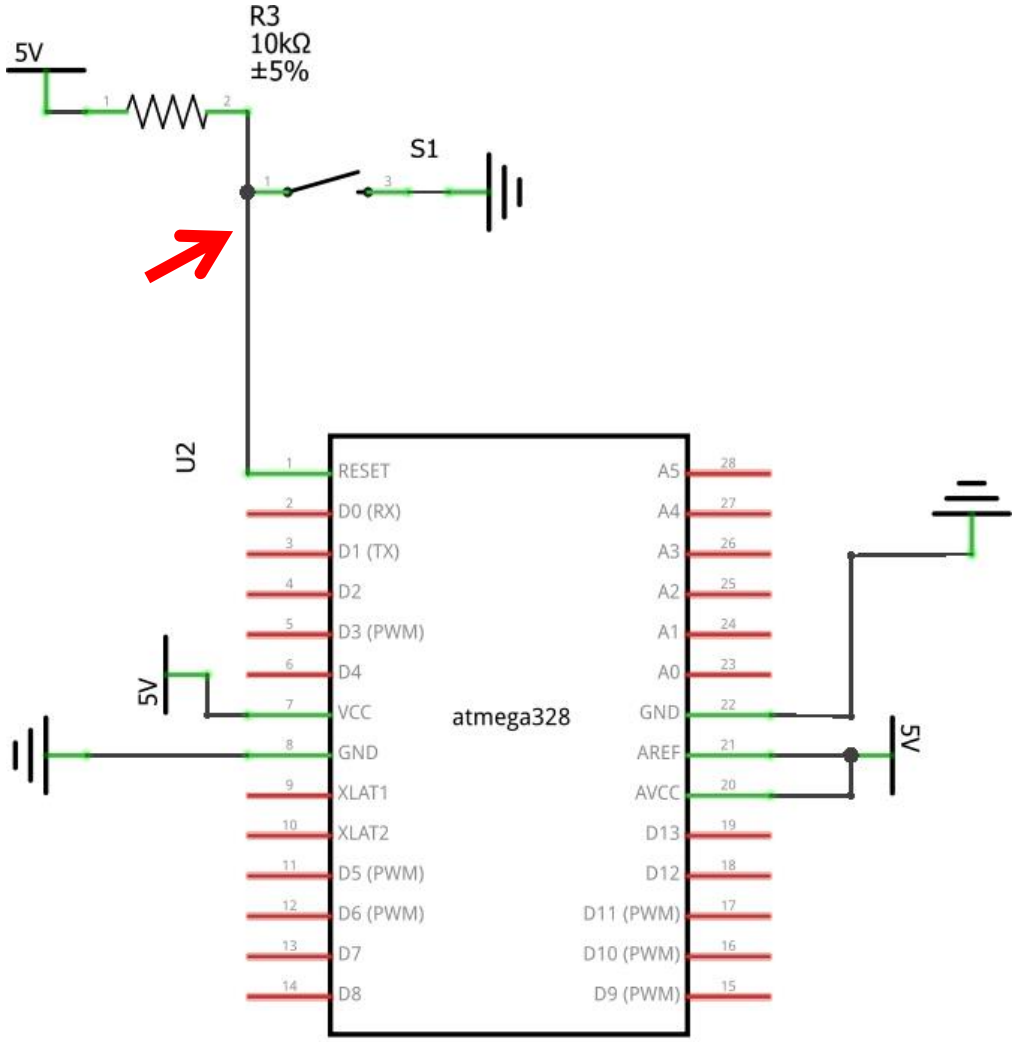


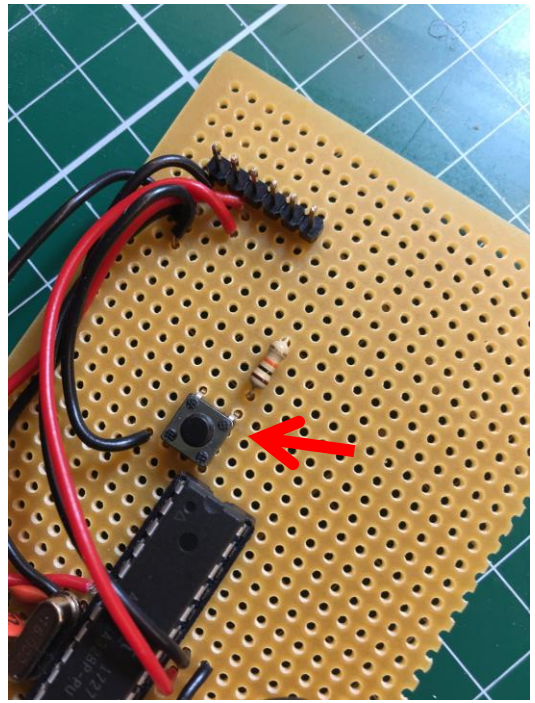




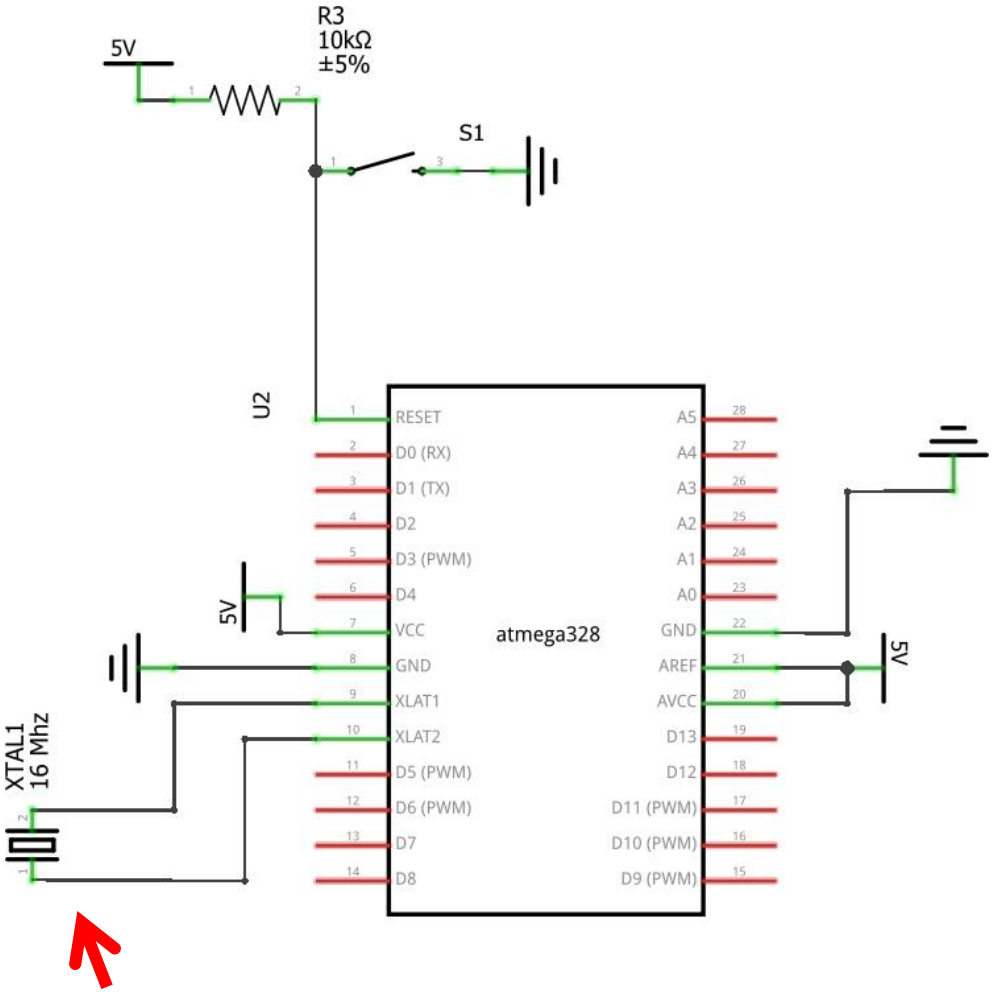
Building your own standalone arduino
Step 4 – Reset Pin

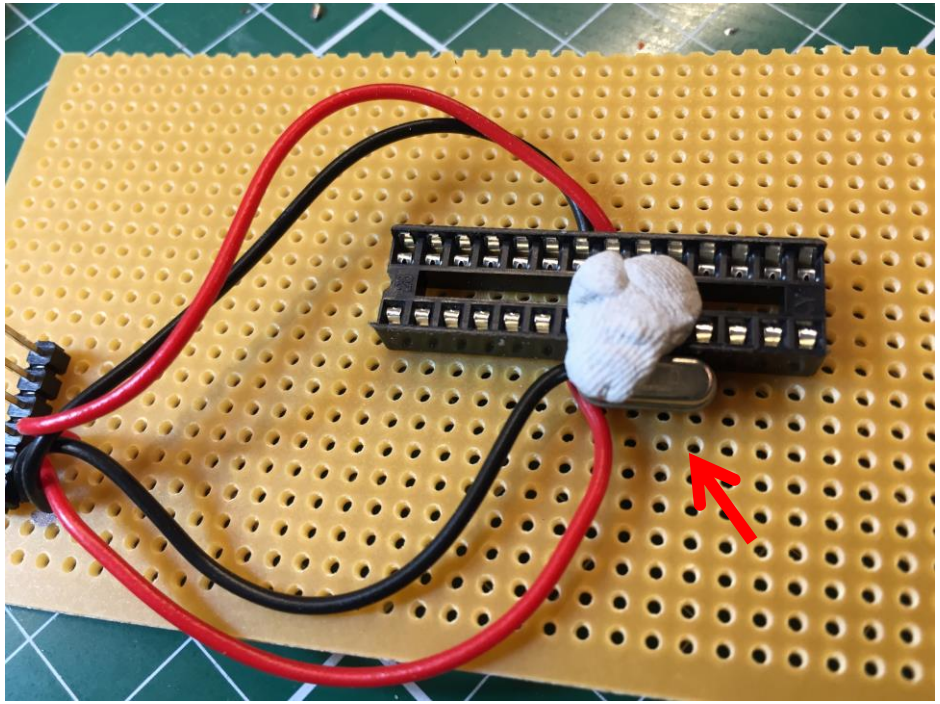




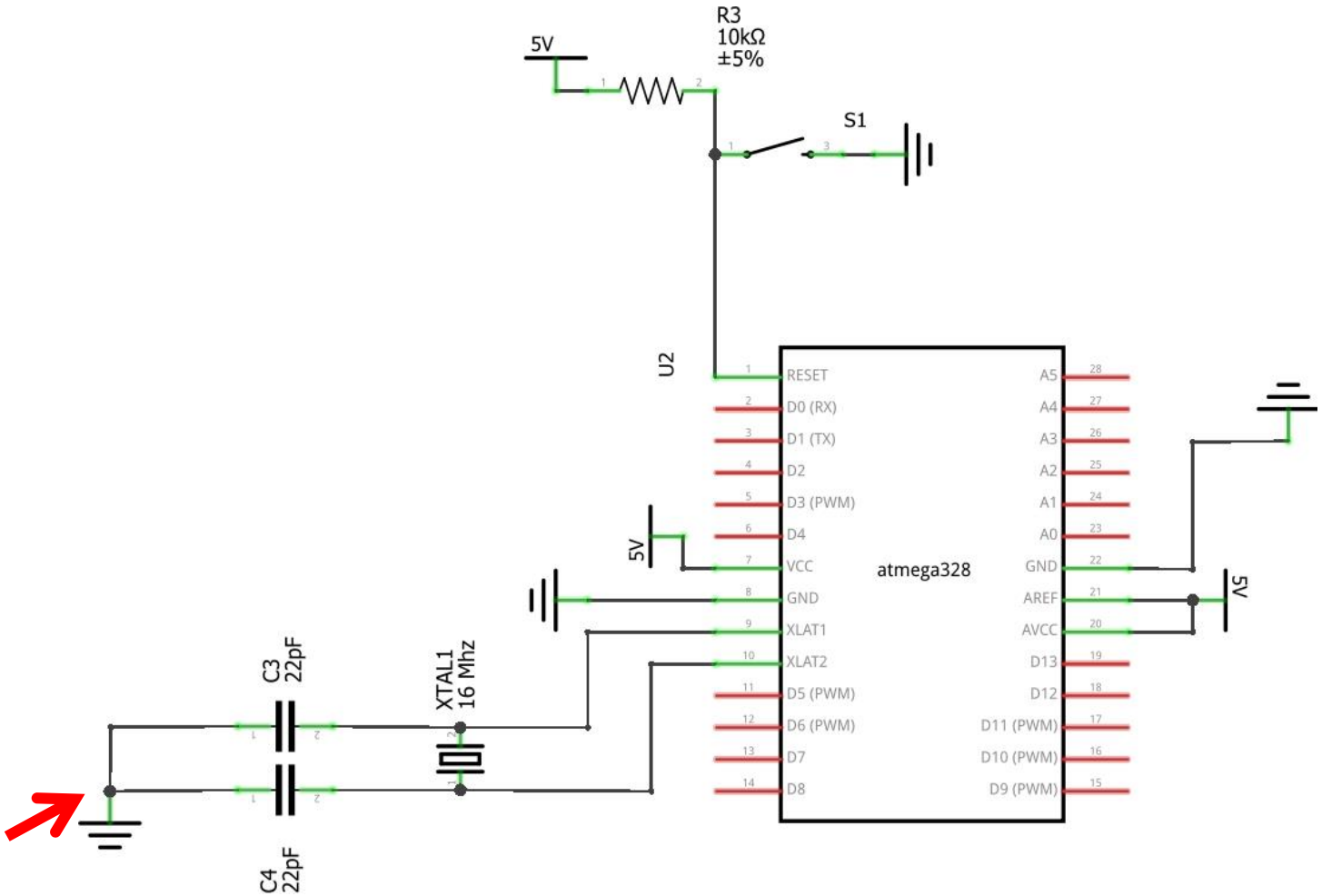


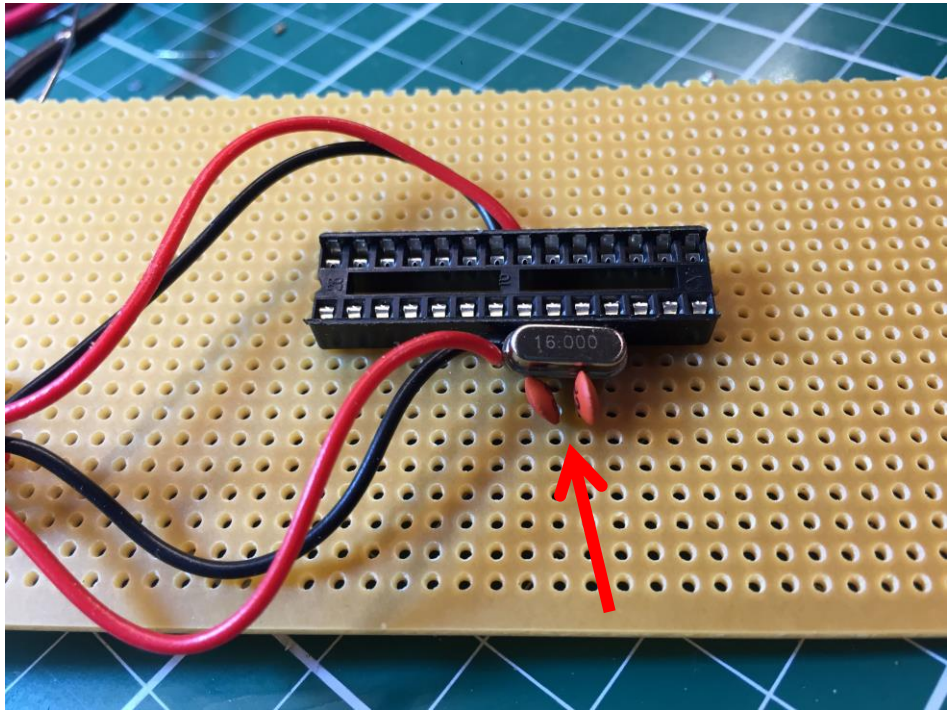
Building your own standalone arduino
Step 5 – Add 16 Mhz Crystal between XLAT1 & XLAT2
There is no polarity



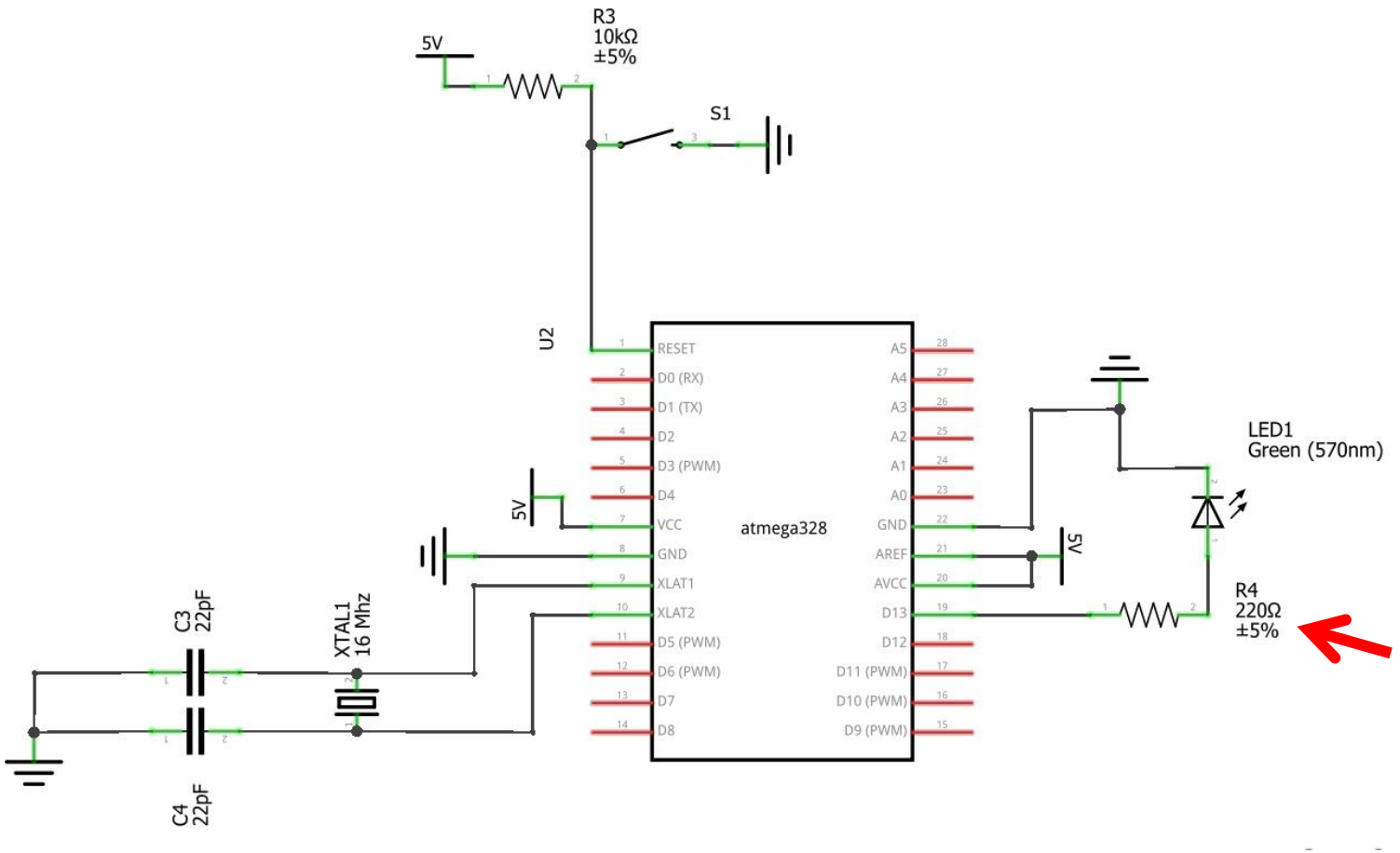


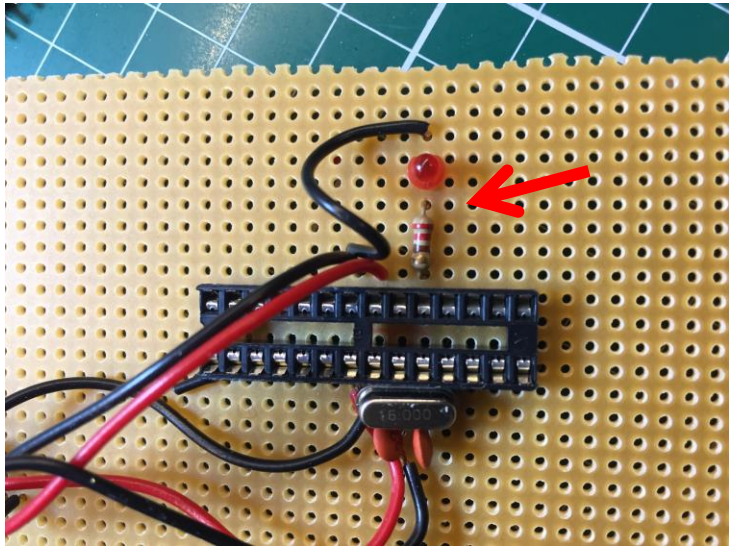
Building your own standalone arduino
Step 6 – Add capacitors to the Crystal connection and Ground them



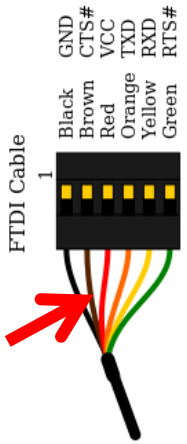


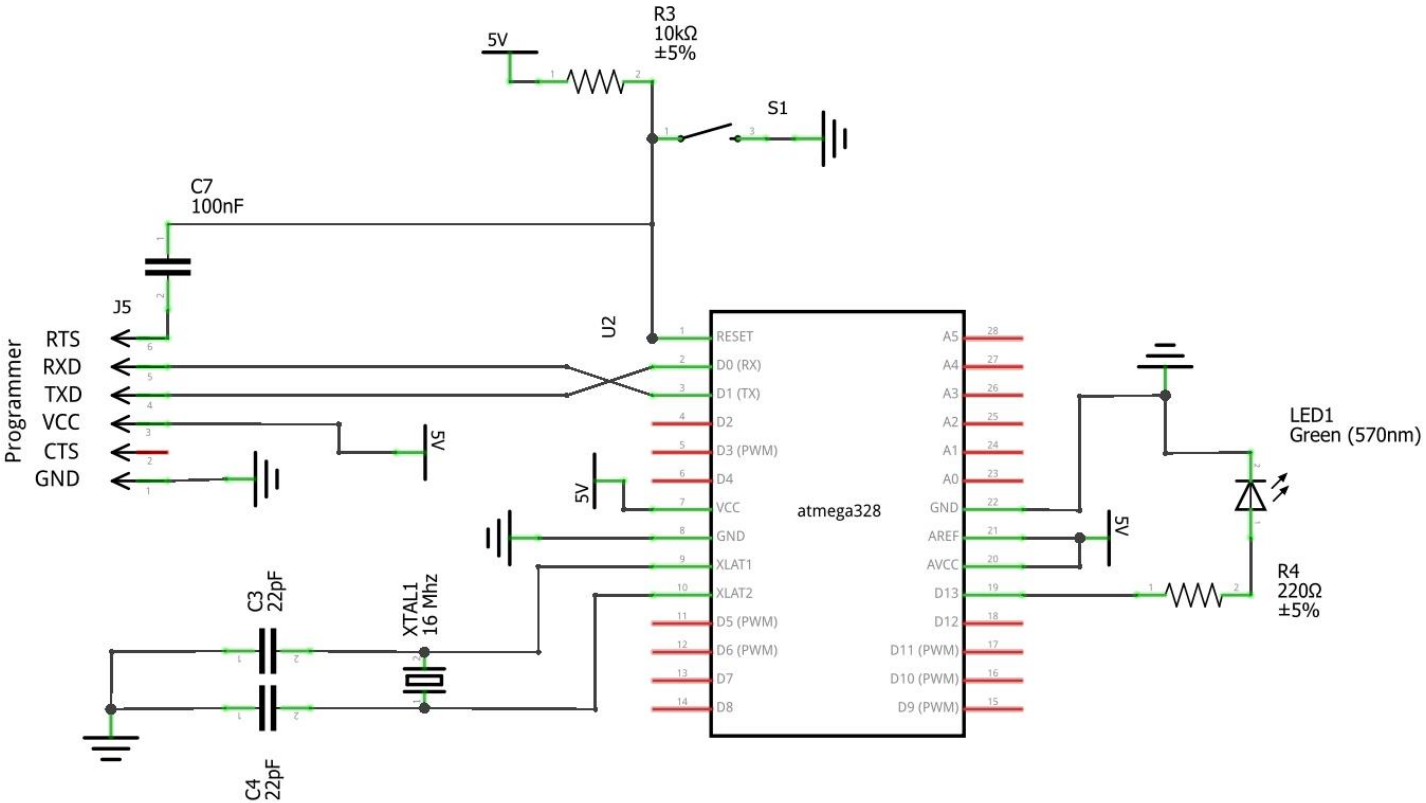
Building your own standalone arduino
Step 7 – Add debuggin LED to pin13

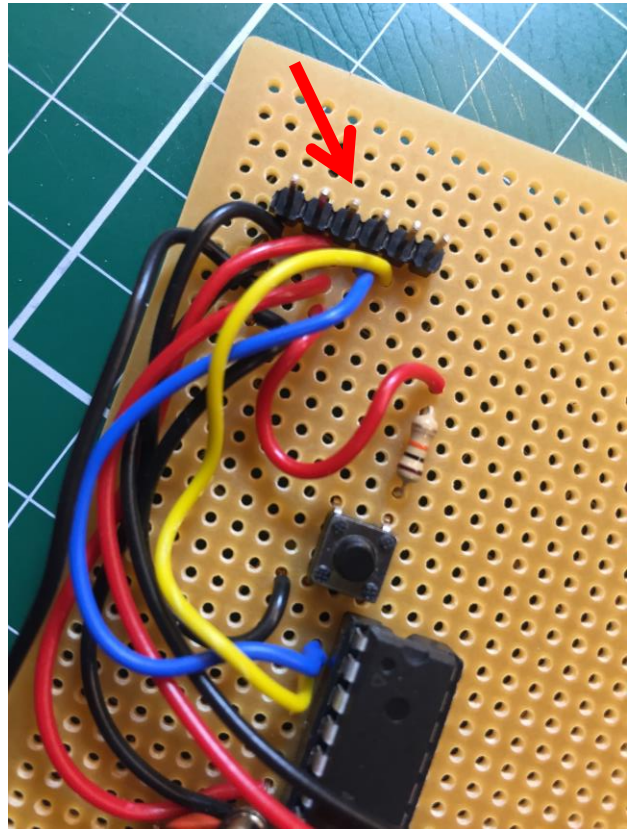




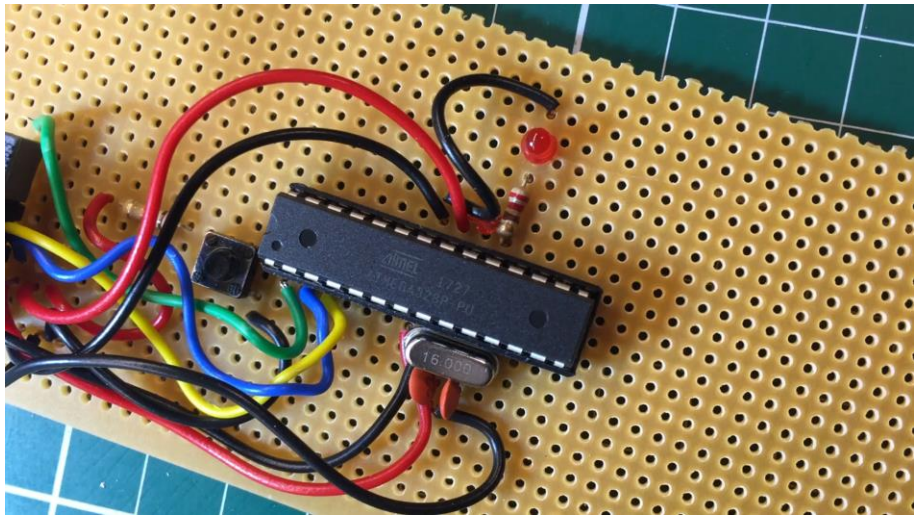
Building your own standalone arduino
Step 8 – Prepare FTDI Programmer Connection
Connect VCC and Ground wiring for FTDI connector
Connect TX RX pins and the RTS Connection
Use a 100 nf capacitor between RTS and Pin0
CTS is left empty

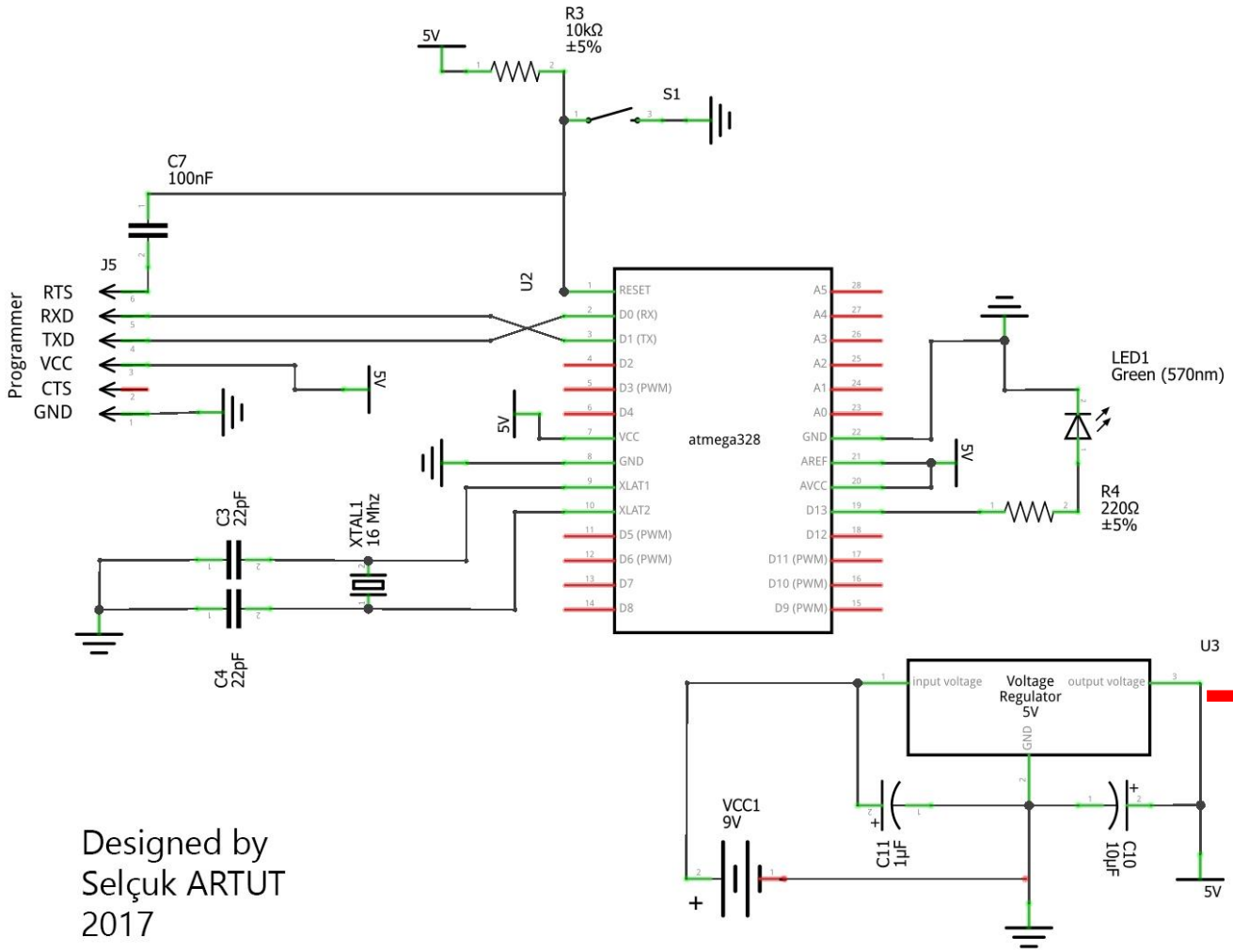


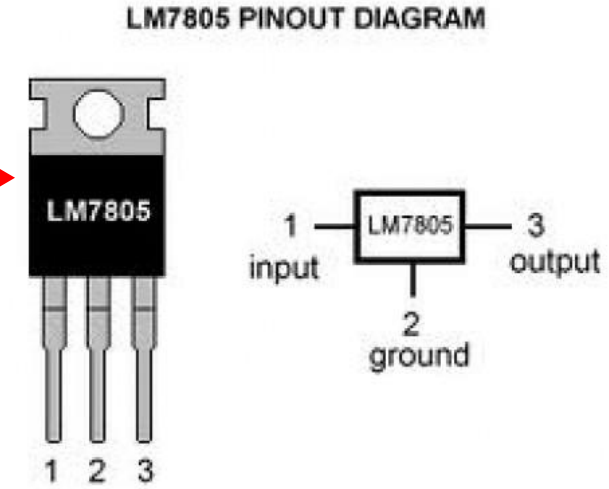




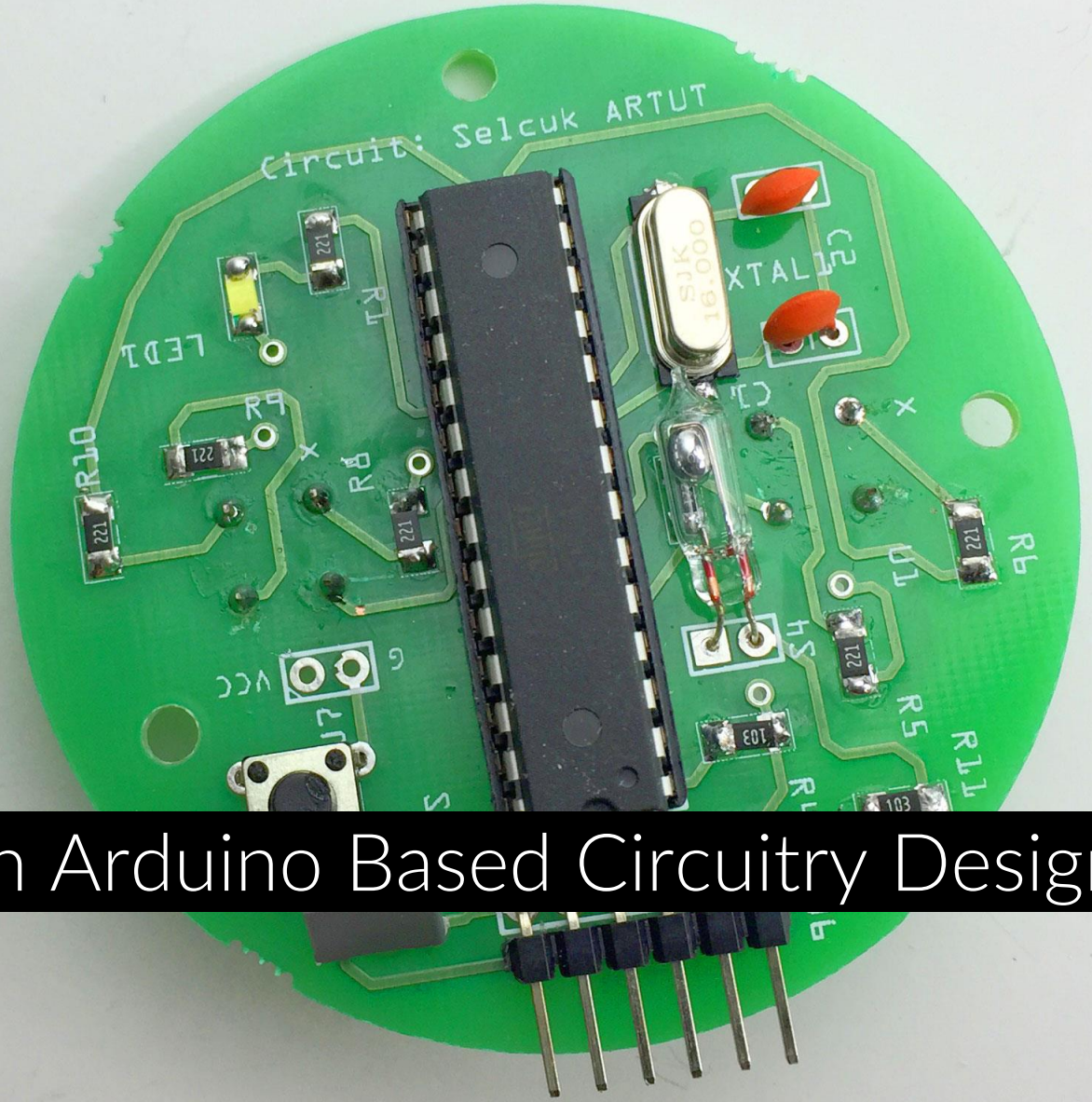
Building your own standalone arduino
Step 11 – External Powering & Voltage Conversion
Is it blinking?





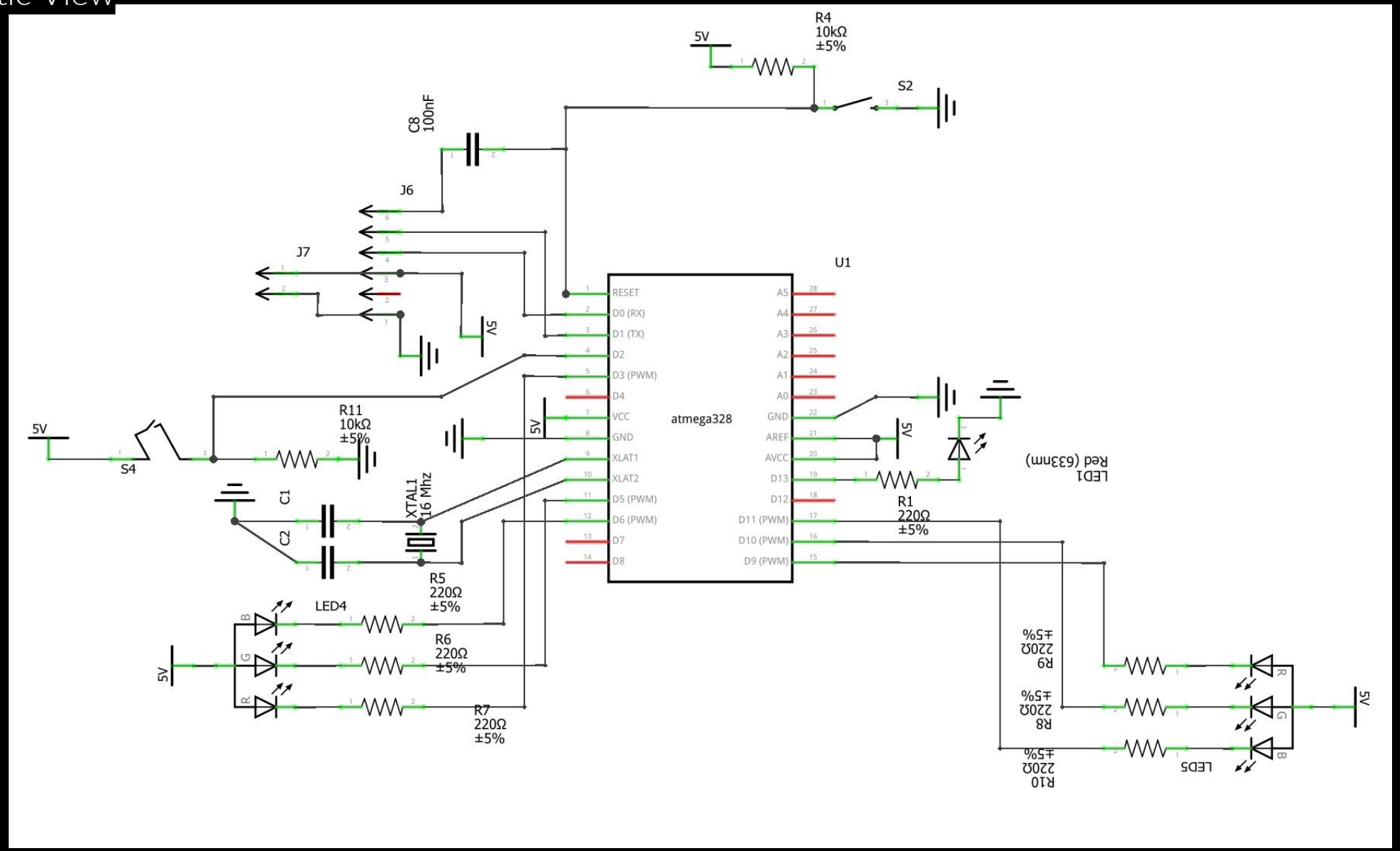


Designed by
Selçuk ARTUT
2017



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

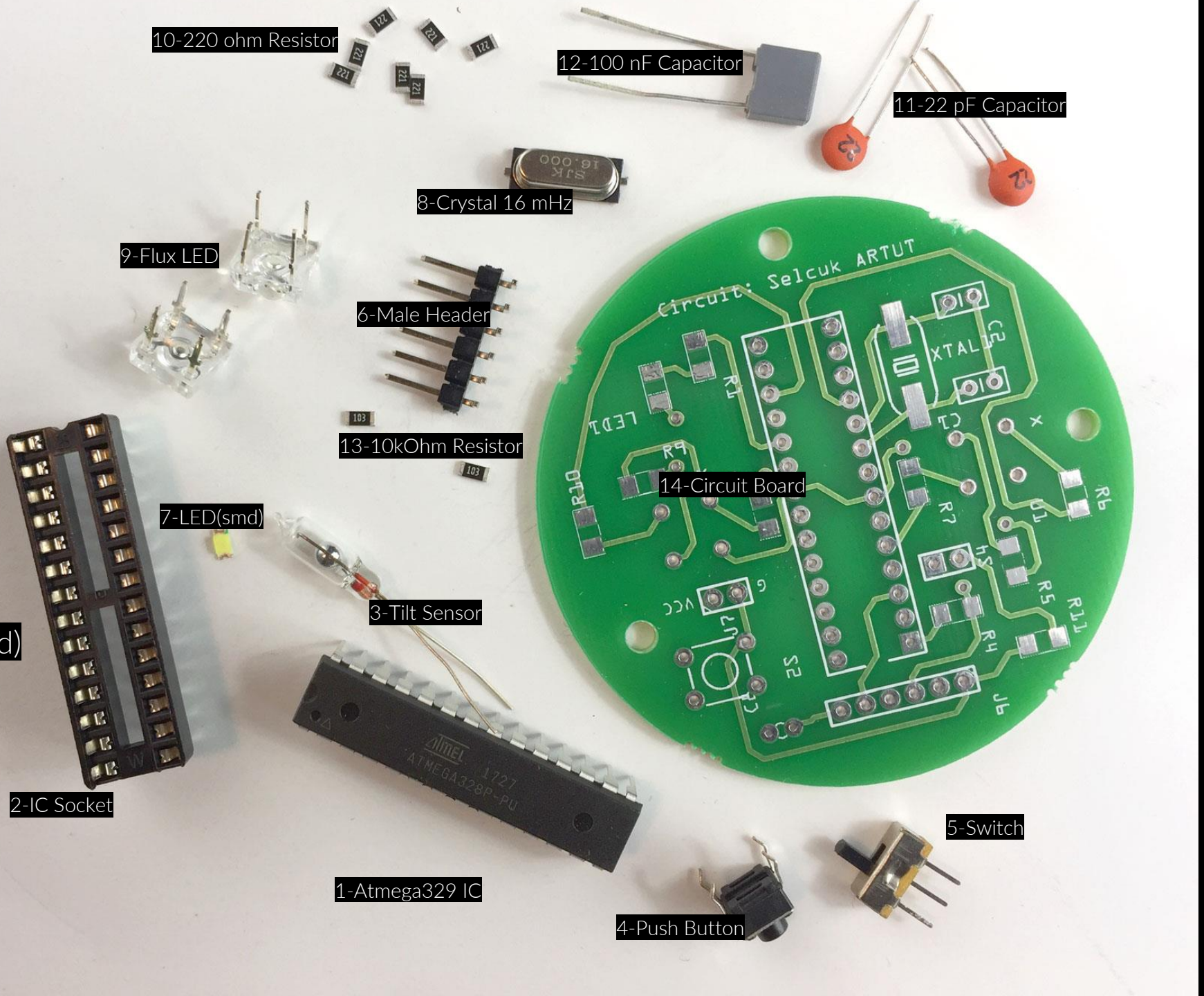
10-220 ohm Resistor (smd)

11-22 pF Capacitor

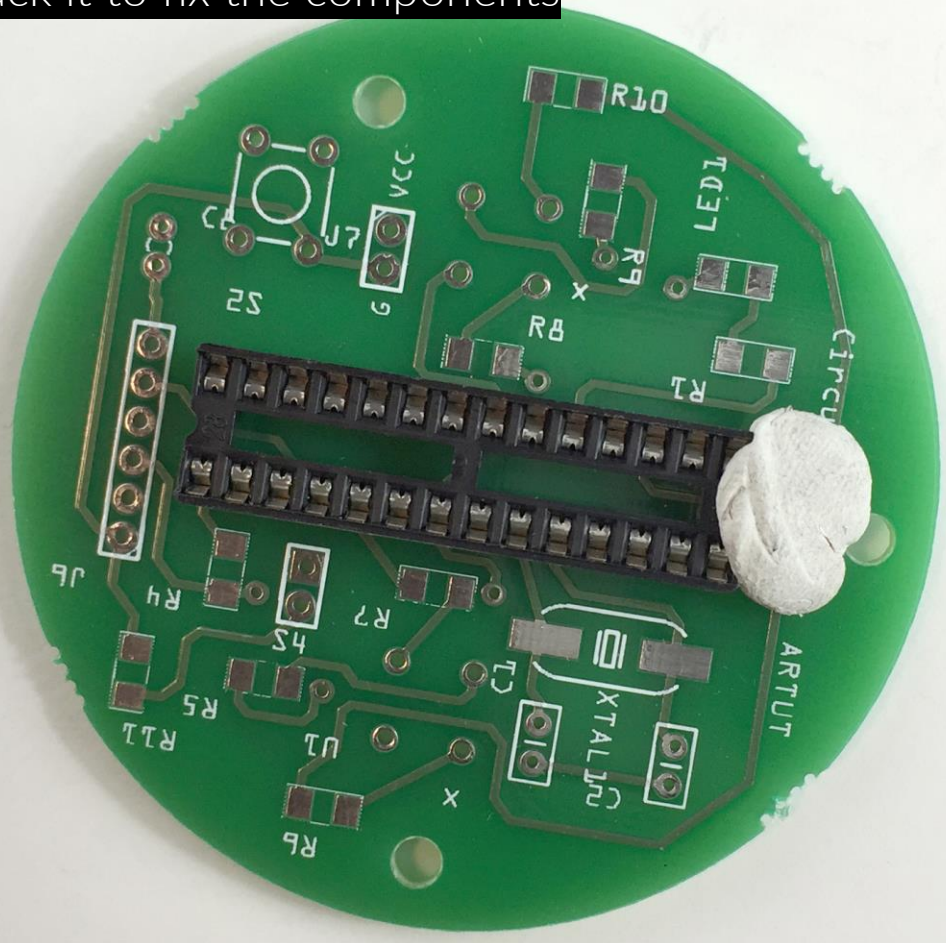
12-100 nf Capacitor

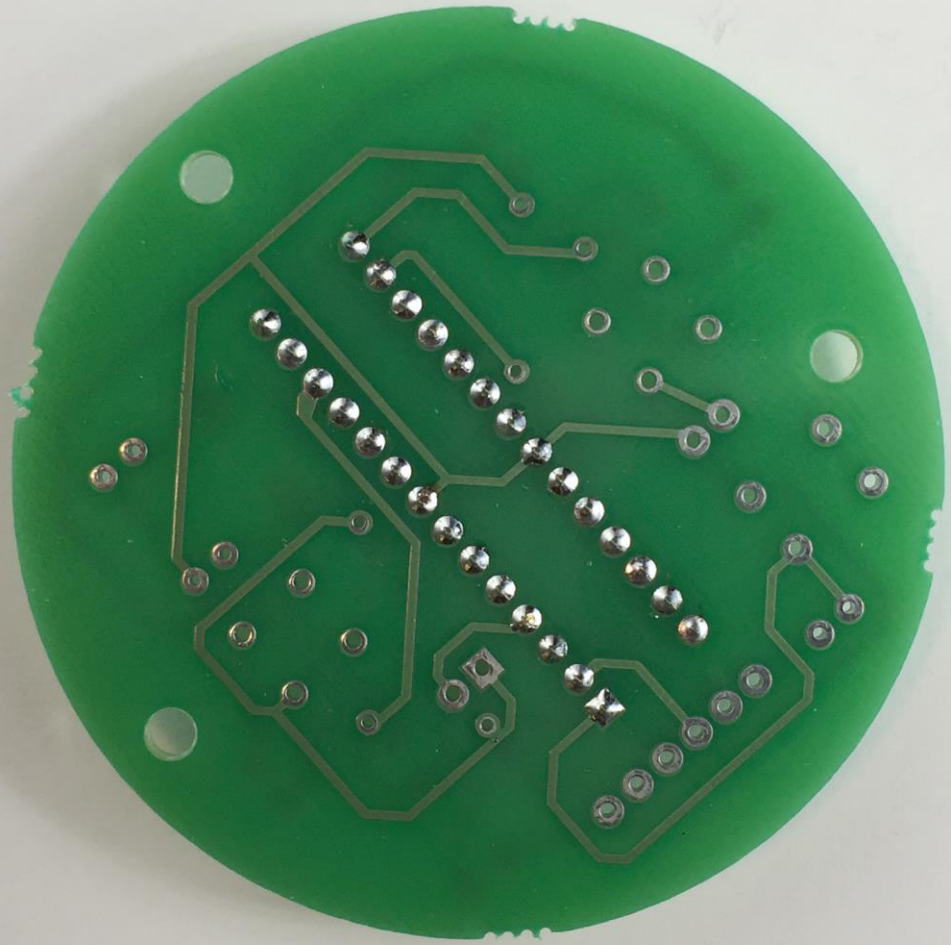
13-10 kOhm Resistor

14-Circuit board



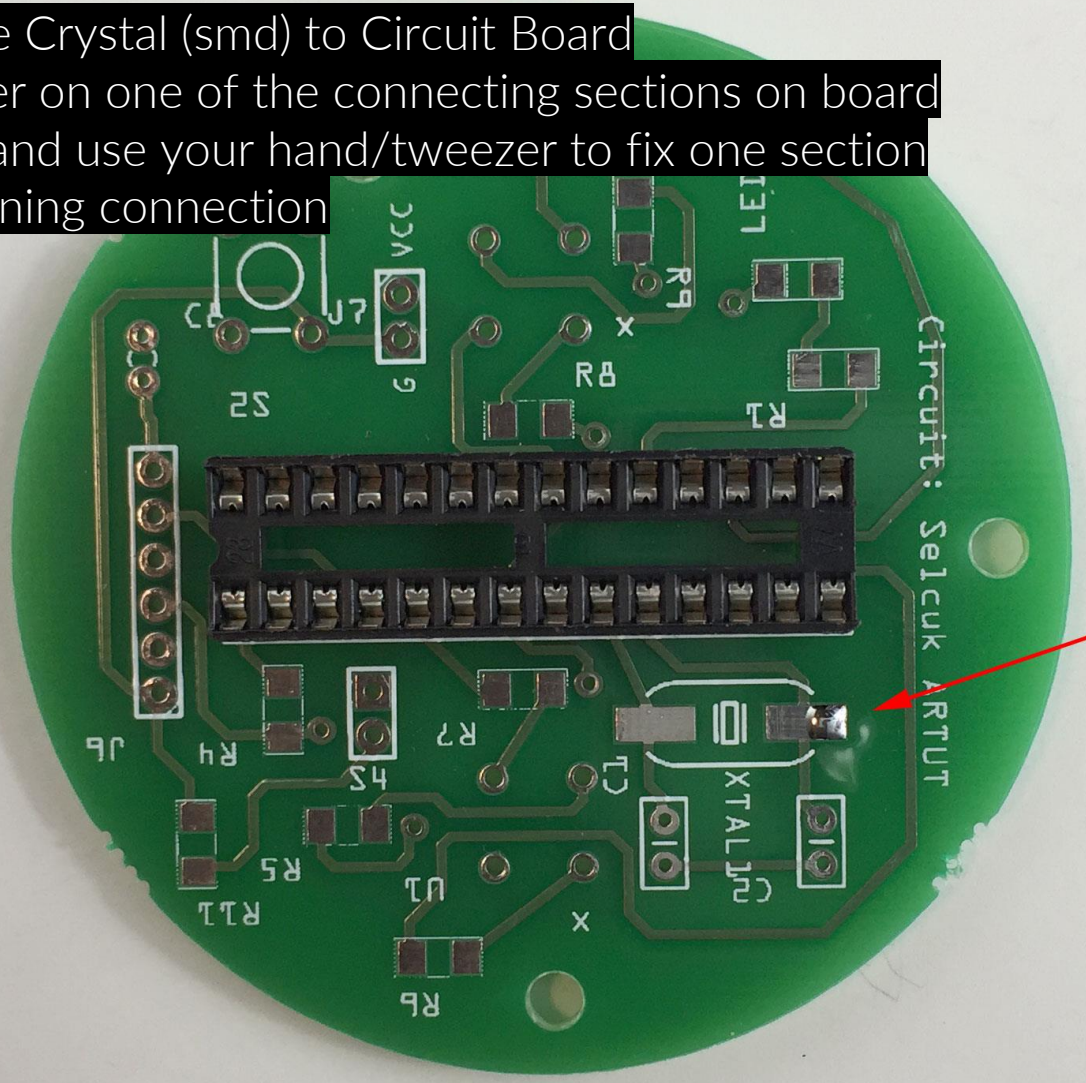
Step 1 : Solder the IC Socket to Circuit Board
Use tack it to fix the components

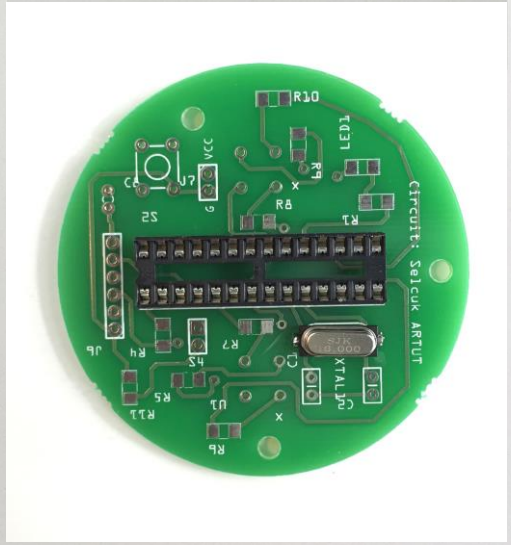




Step 2 : Solder the Crystal (smd) to Circuit Board

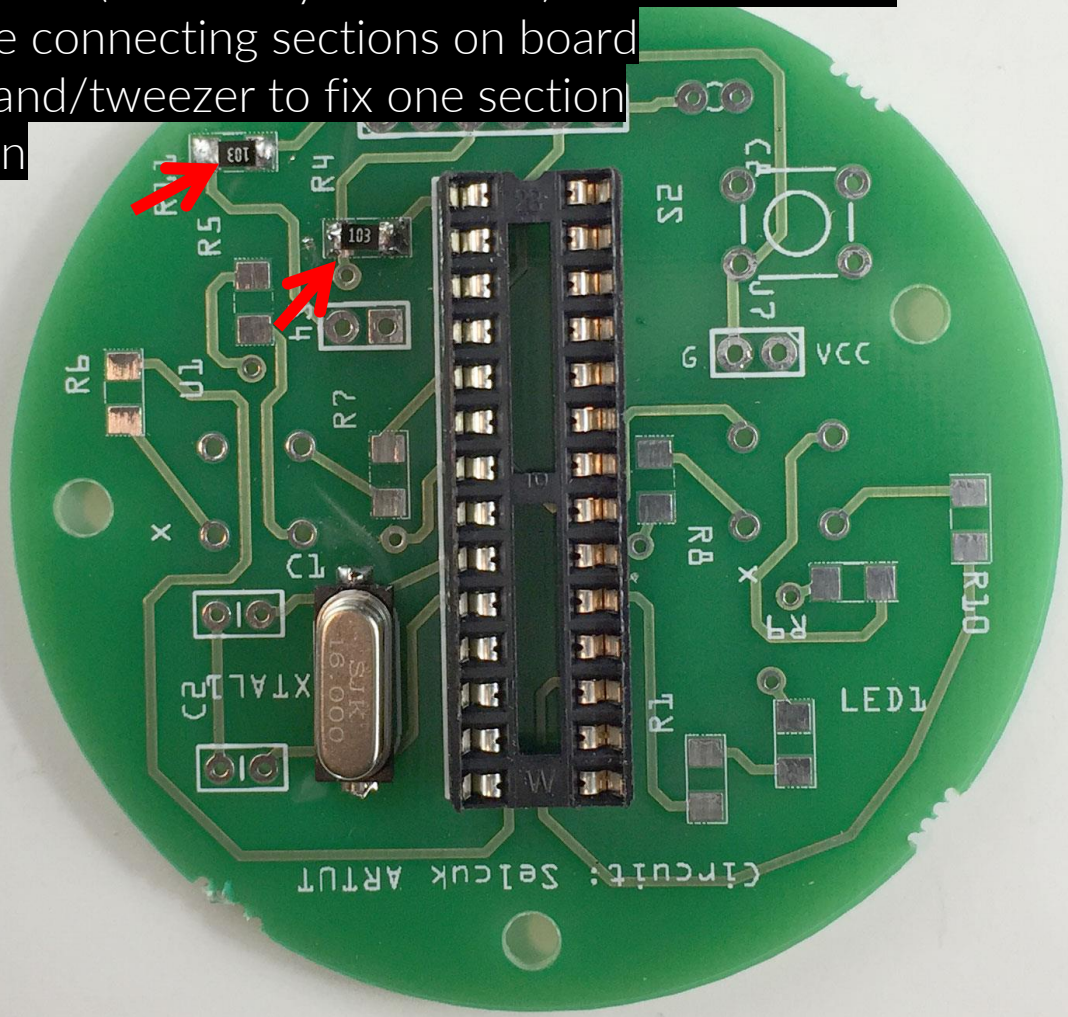
- Put a bit of solder on one of the connecting sections on board
- Melt the solder and use your hand/tweezer to fix one section
- Solder the remaining connection





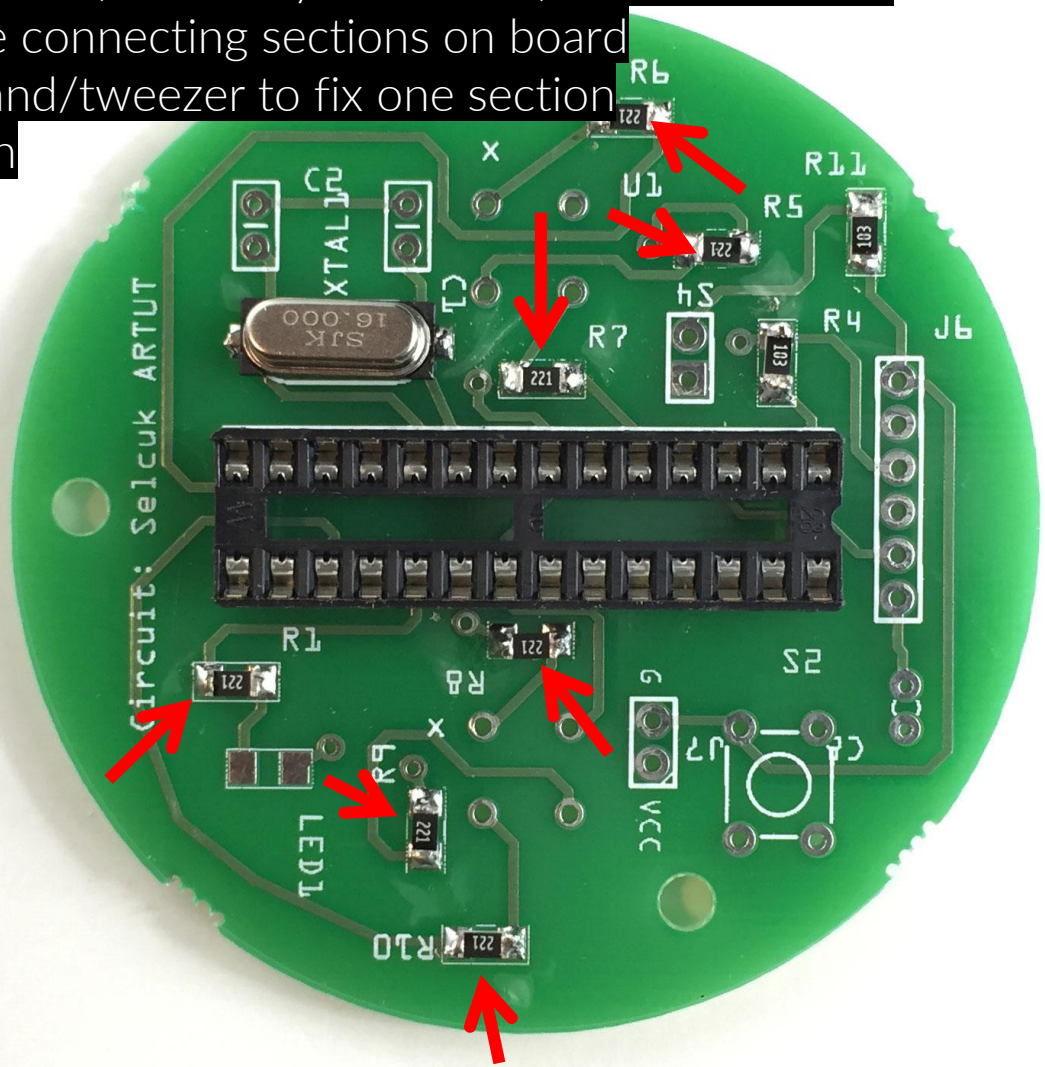
Step 4 : Solder the 10kOhm Resistor (smd-it says 103 on it) to Circuit Board

- 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



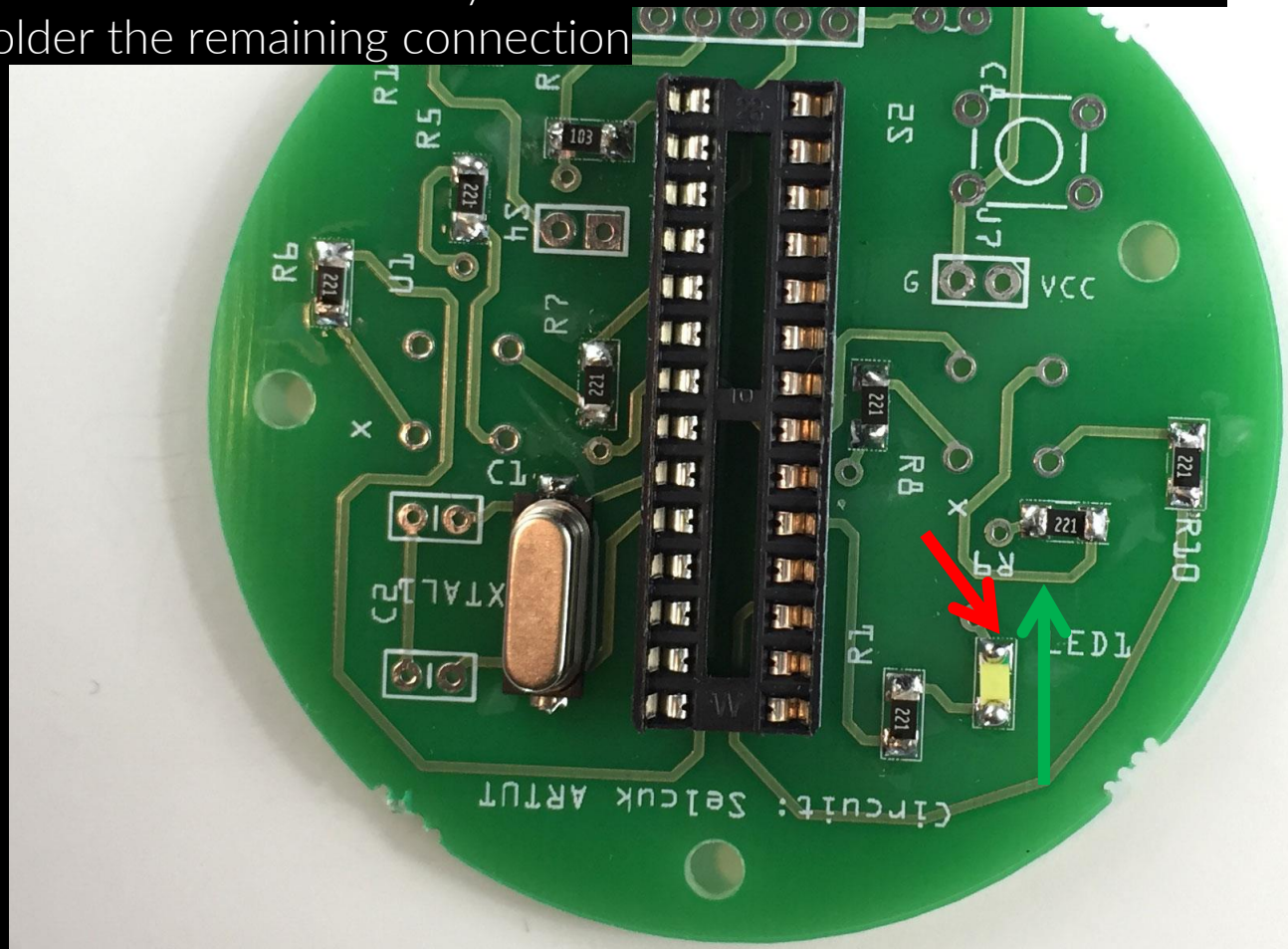
Step 5 : Solder the 220 ohm Resistor (smd-it says 221 on it) to Circuit Board

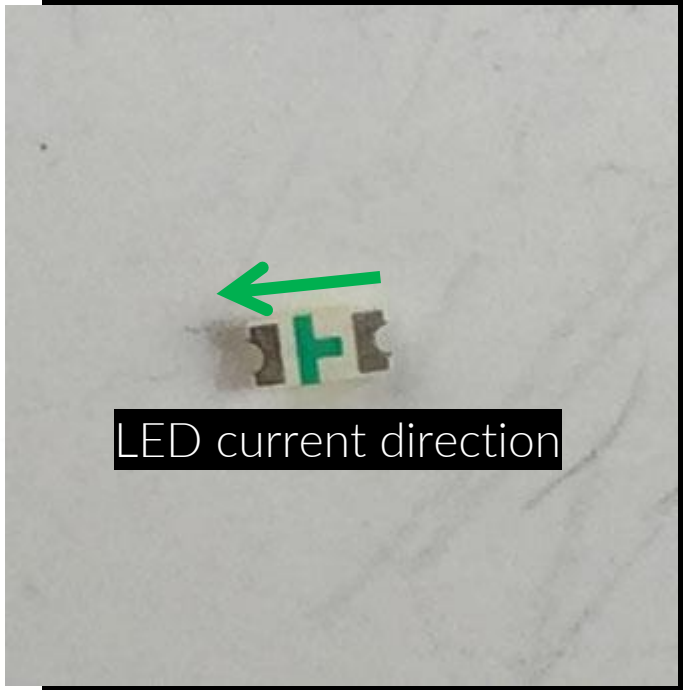
- Put a bit of solder on one of the connecting sections on board
- Melt the solder and use your hand/tweezer to fix one section
- Solder the remaining connection



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

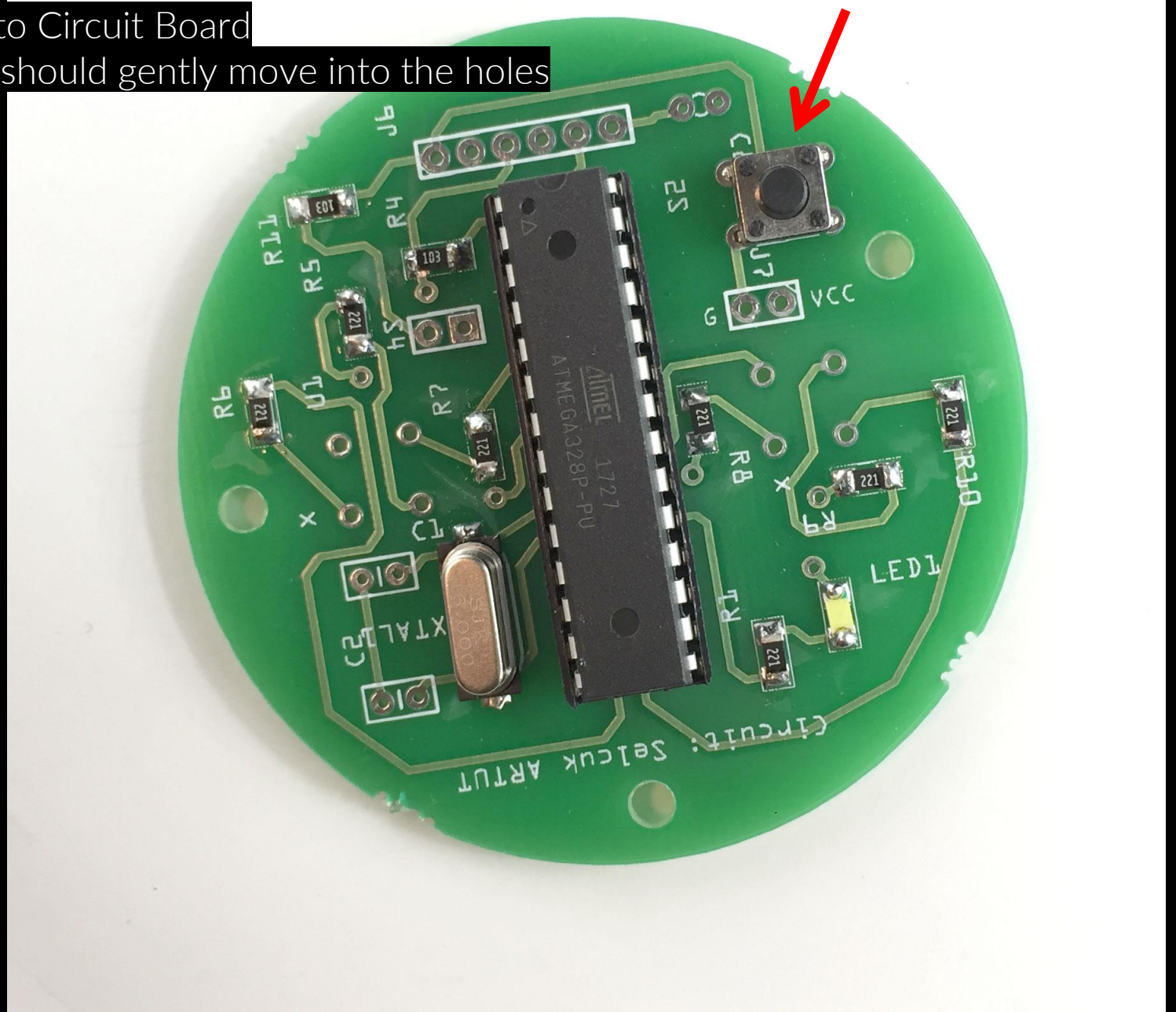




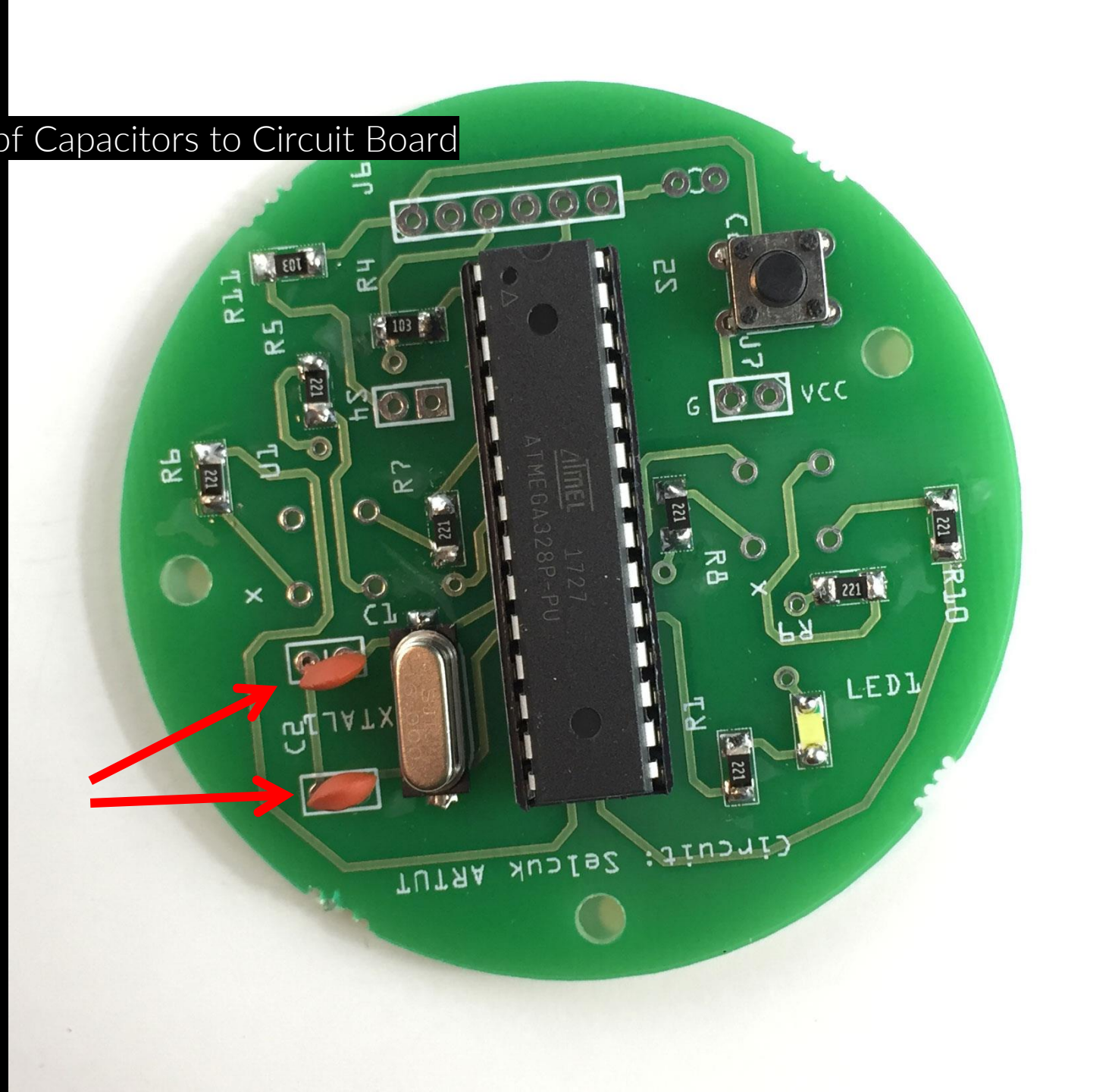
LED current direction

Step 7 : Solder the Push Button to Circuit Board

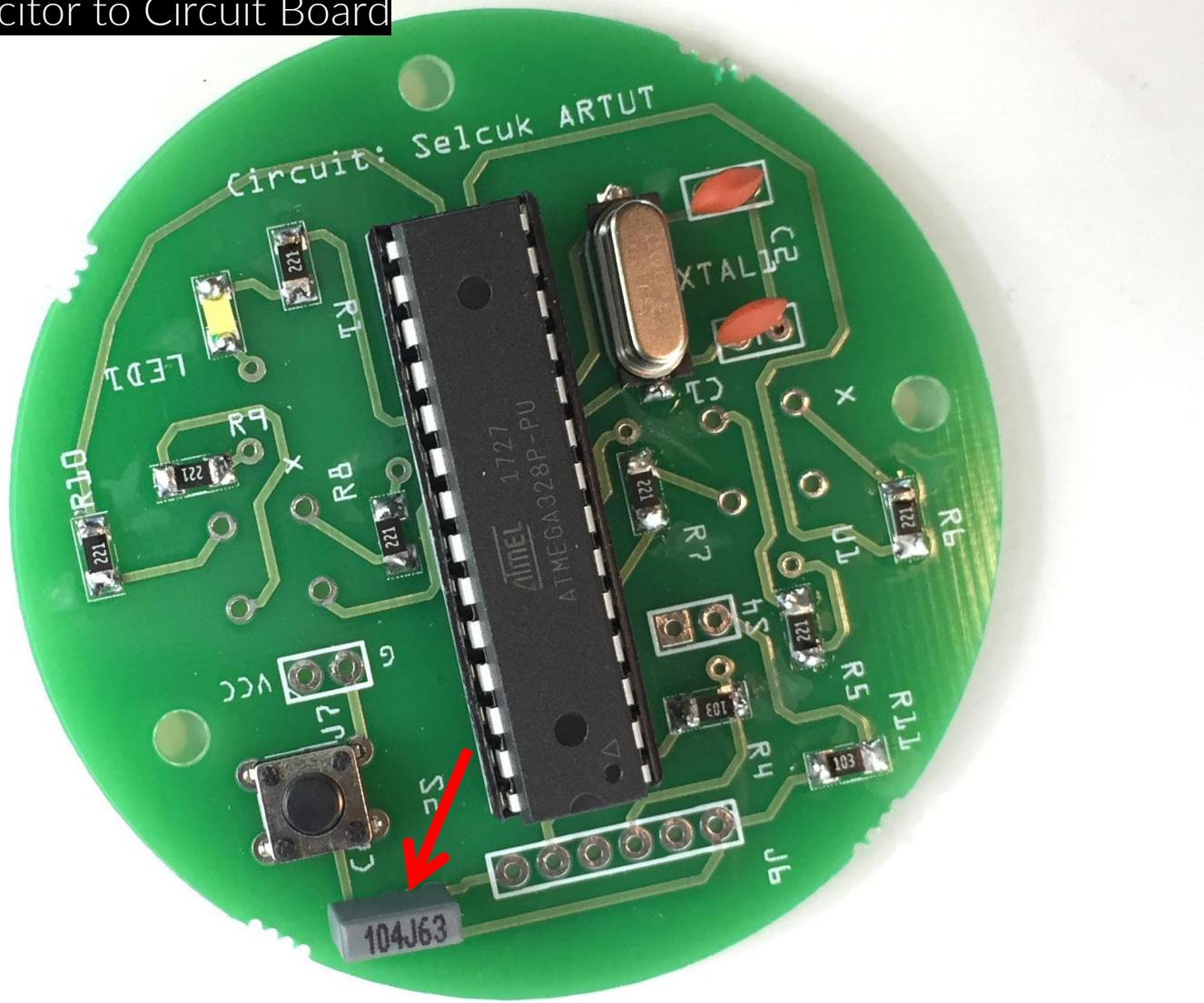
- Be aware of its leg positions, it should gently move into the holes



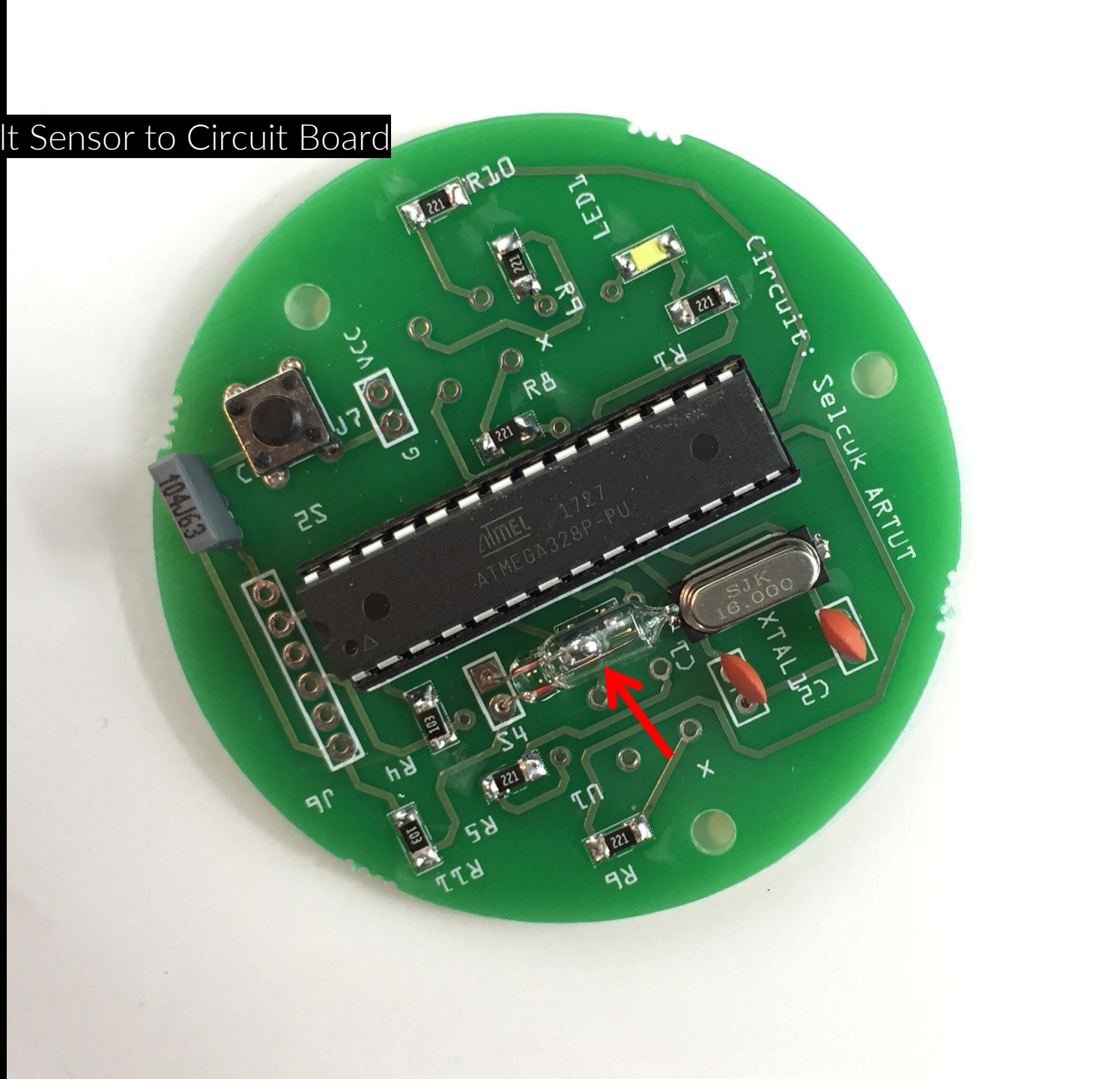
Step 8 : Solder the 22 pf Capacitors to Circuit Board



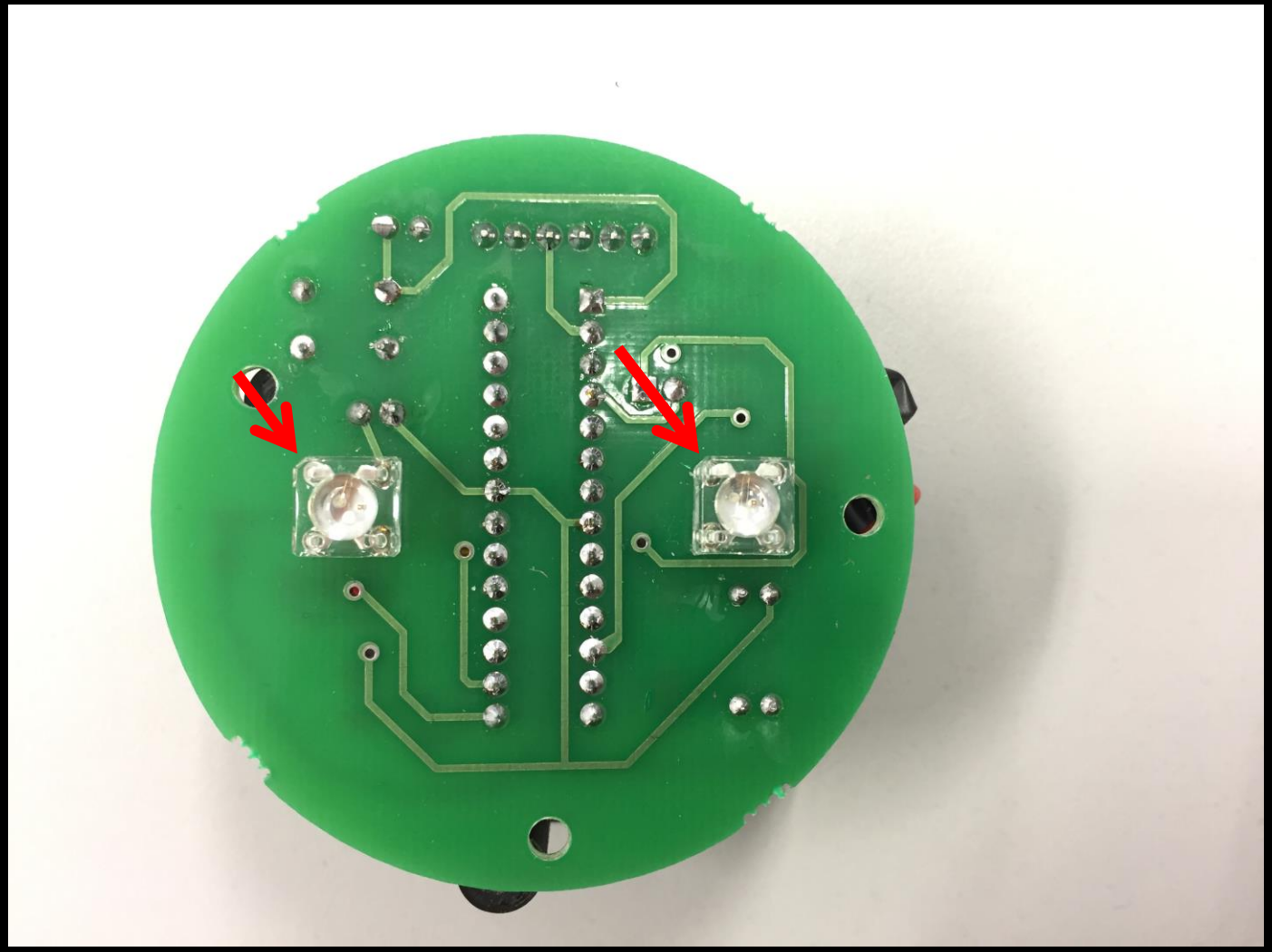
Step 9 : Solder the 100 nf Capacitor to Circuit Board



Step 10 : Solder the Tilt Sensor to Circuit Board

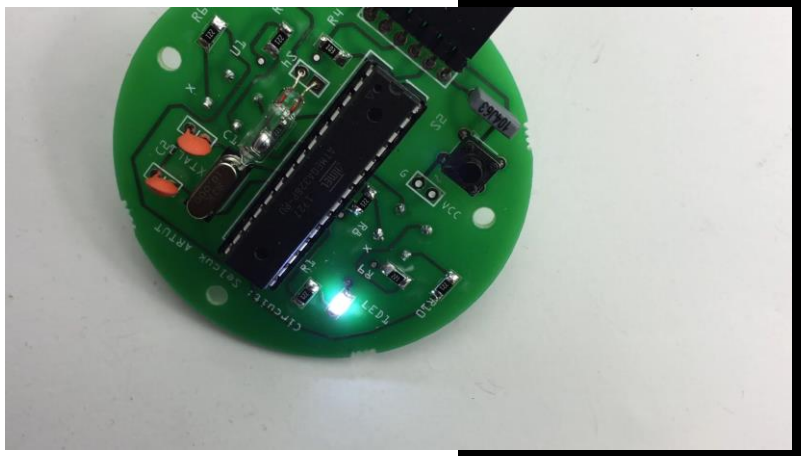


Step 11 : Solder the flux leds to Circuit Board
- Be aware of the sliced edge for the positioning



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

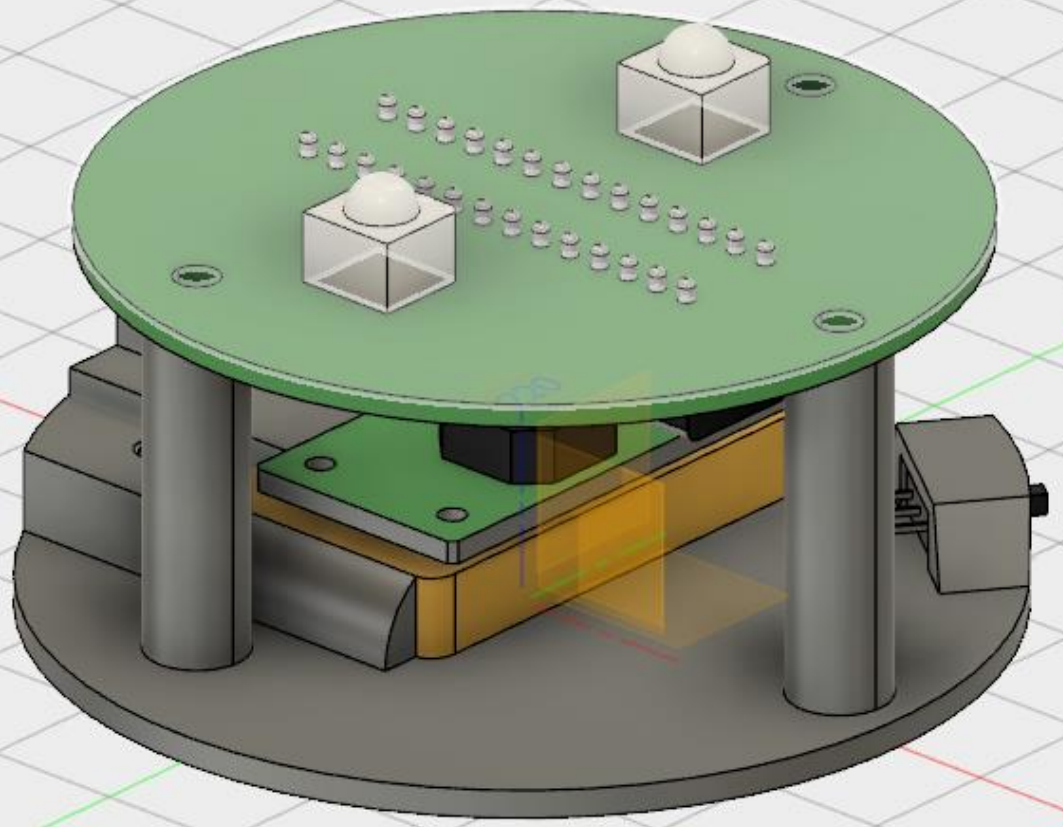
- Apply ftdi connection
- if all is good, it should blink



Part 3 : Accurate Prototyping – Designing an Enclosure

A Workflow Proposal

Final Stage



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ENGLISH

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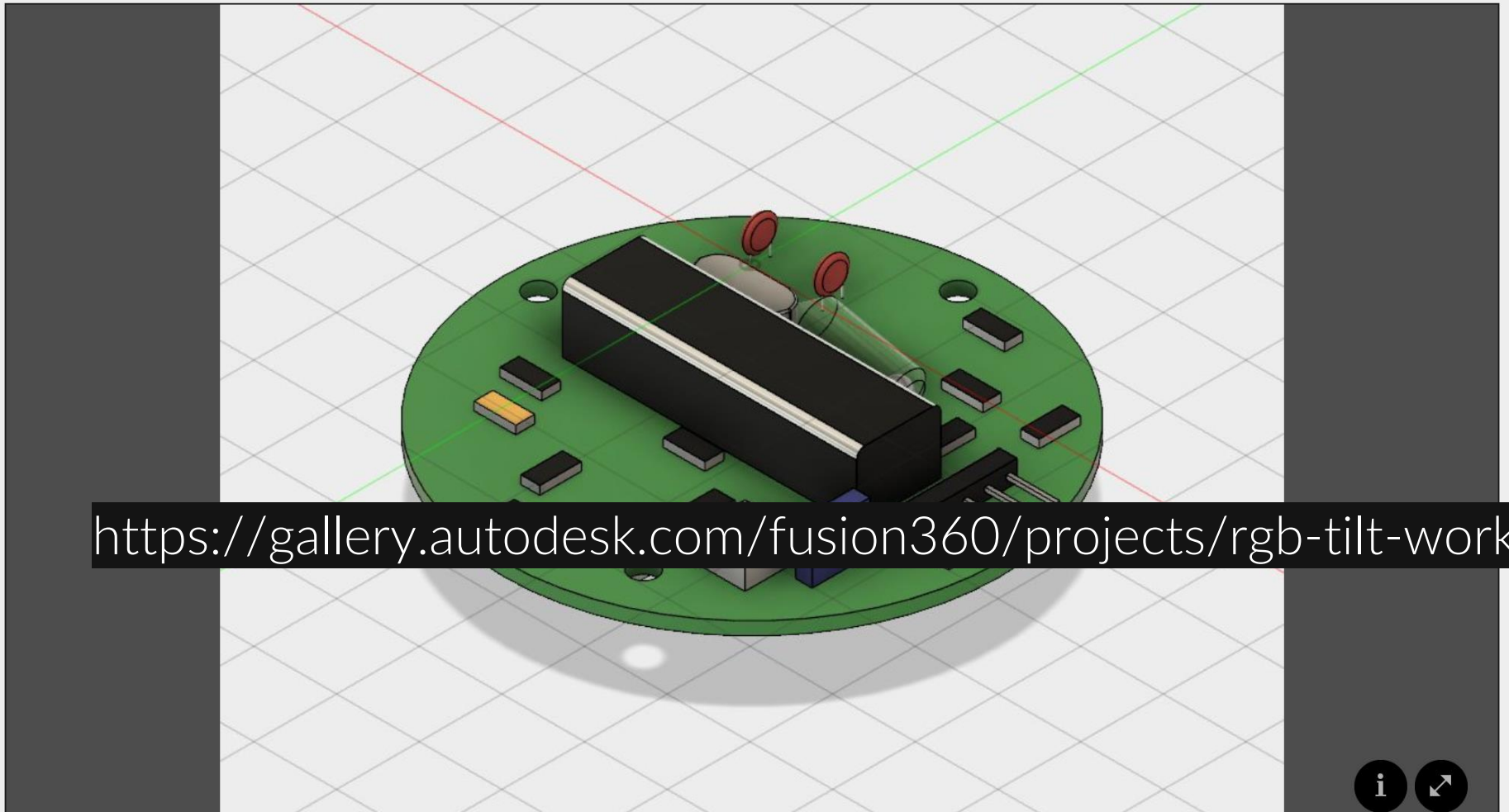
RGB Tilt Workshop Project 3/27/2018



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

Selcuk ARTUT

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Statistics

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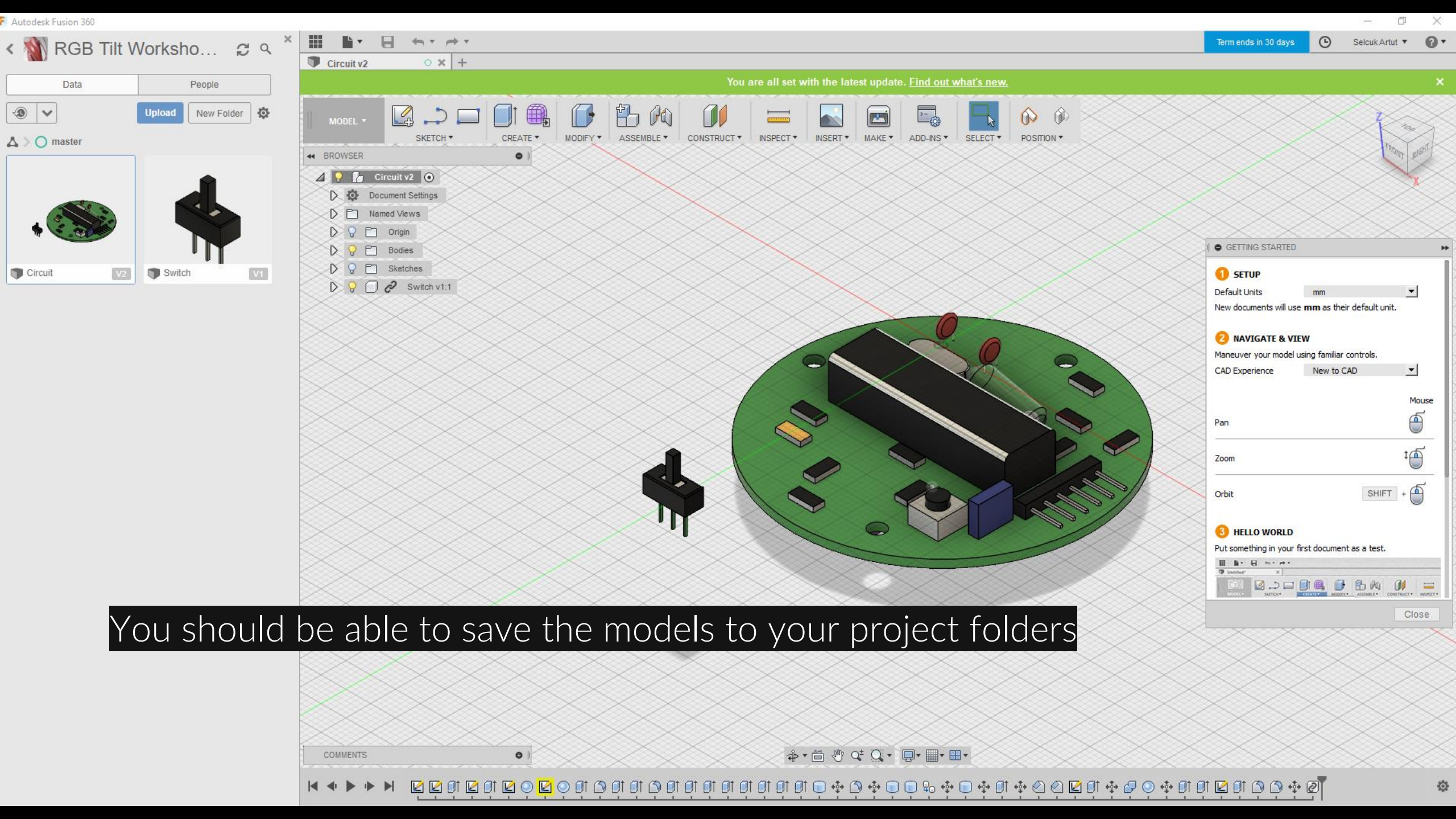
Industries

Media & Entertainment

Product Design & Manufacturing


Autodesk Fusion 360
RGB Tilt Worksho…
Data
People
Upload
New Folder
master
Circuit
V2
Switch
V1
Circuit v2
Term ends in 30 days
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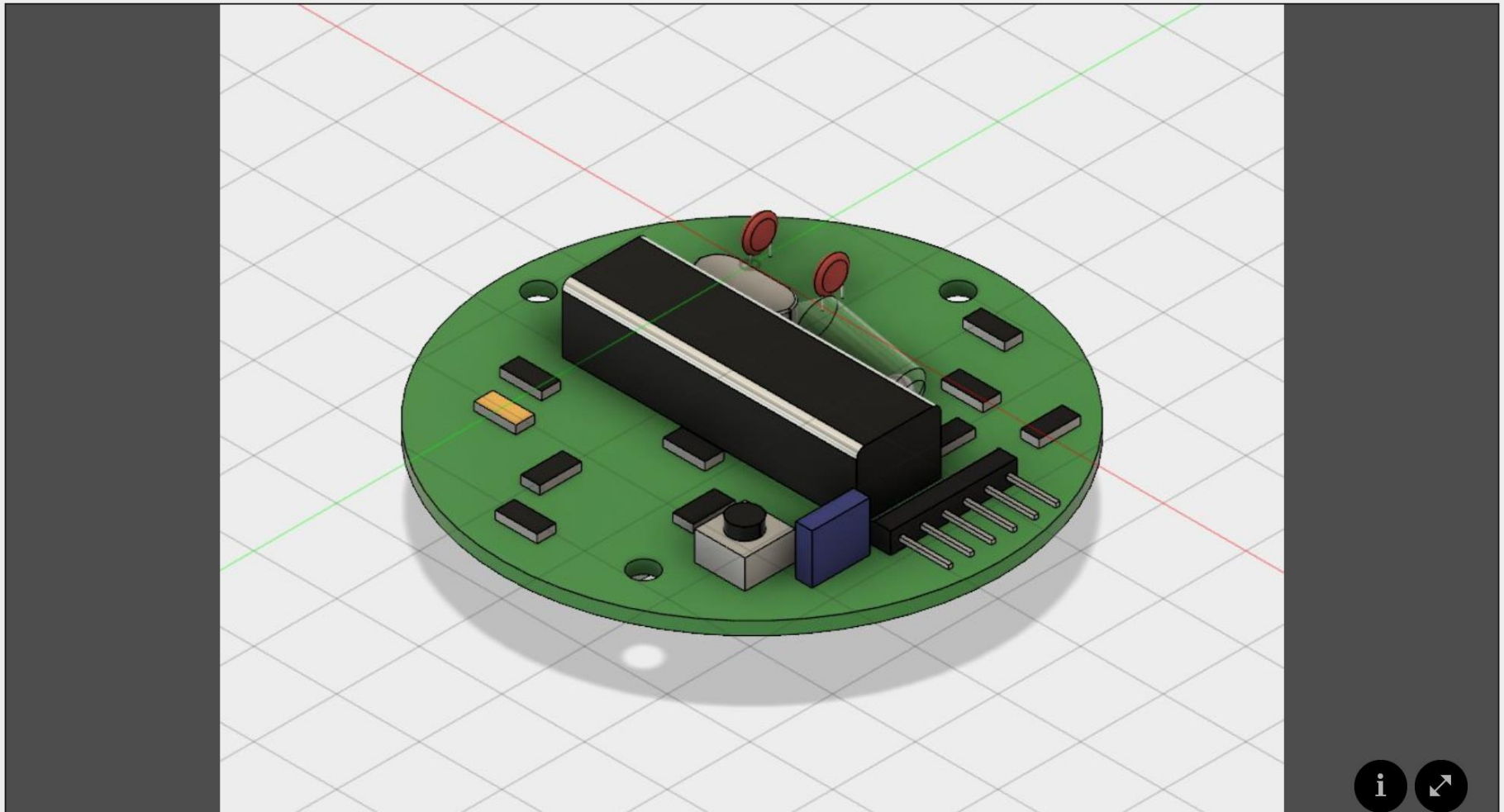
You are all set with the latest update. Find out what's new.
MODEL
SKETCH
CREATE
MODIFY
ASSEMBLE
CONSTRUCT
INSPECT
INSERT
MAKE
ADD-INS
SELECT
POSITION
BROWSER
Circuit v2
Document Settings
Named Views
Origin
Bodies
Sketches
Switch v1:1
GETTING STARTED
1 SETUP
Default Units
mm
New documents will use mm as their default unit.
2 NAVIGATE & VIEW
Maneuver your model using familiar controls.
CAD Experience
New to CAD
Mouse
Pan
Zoom
Orbit
SHIFT
3 HELLO WORLD
Put something in your first document as a test.
Close
COMMENTS
You should be able to save the models to your project folders

RGB Tilt Workshop Project

3/27/2018



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Industries

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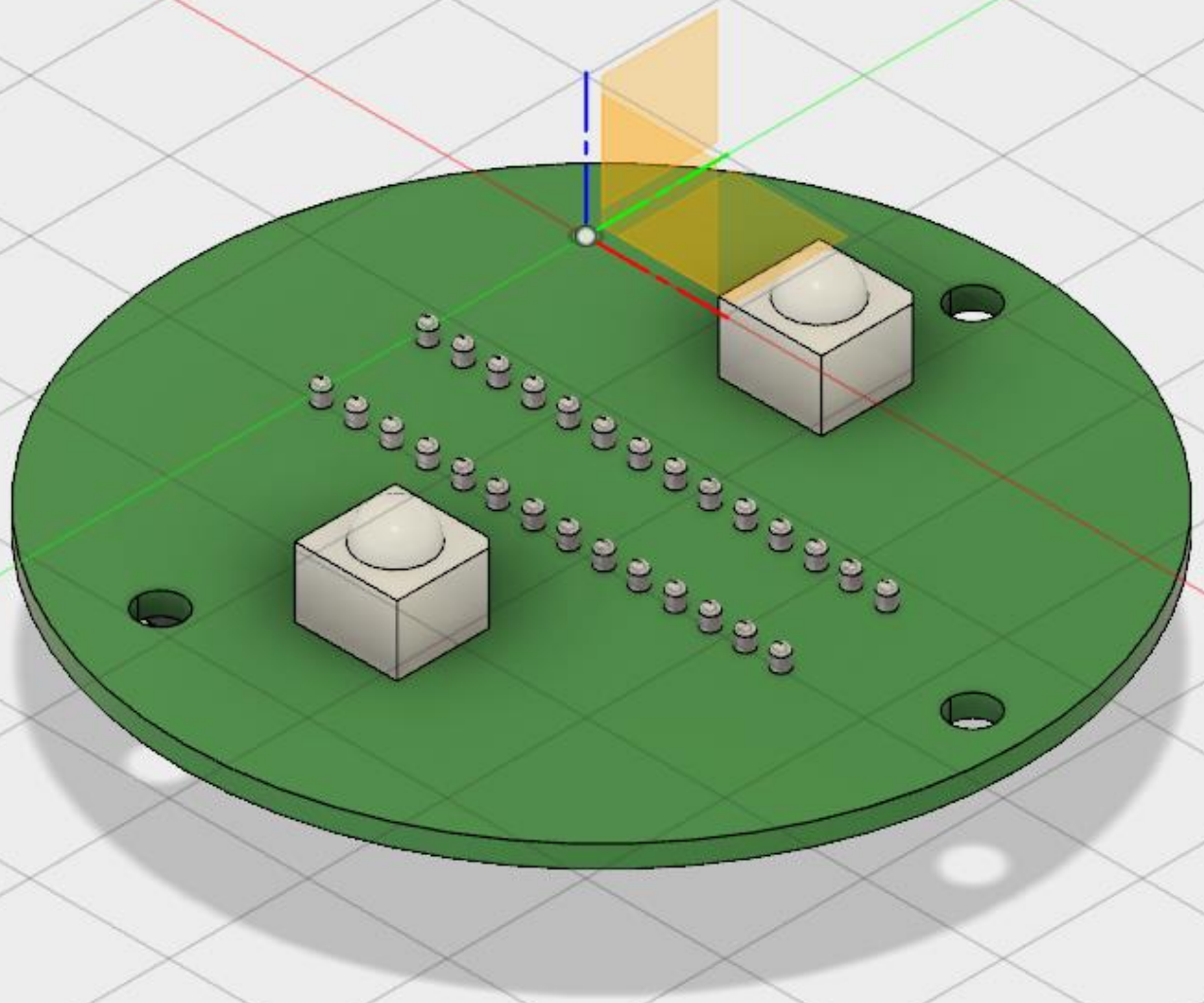
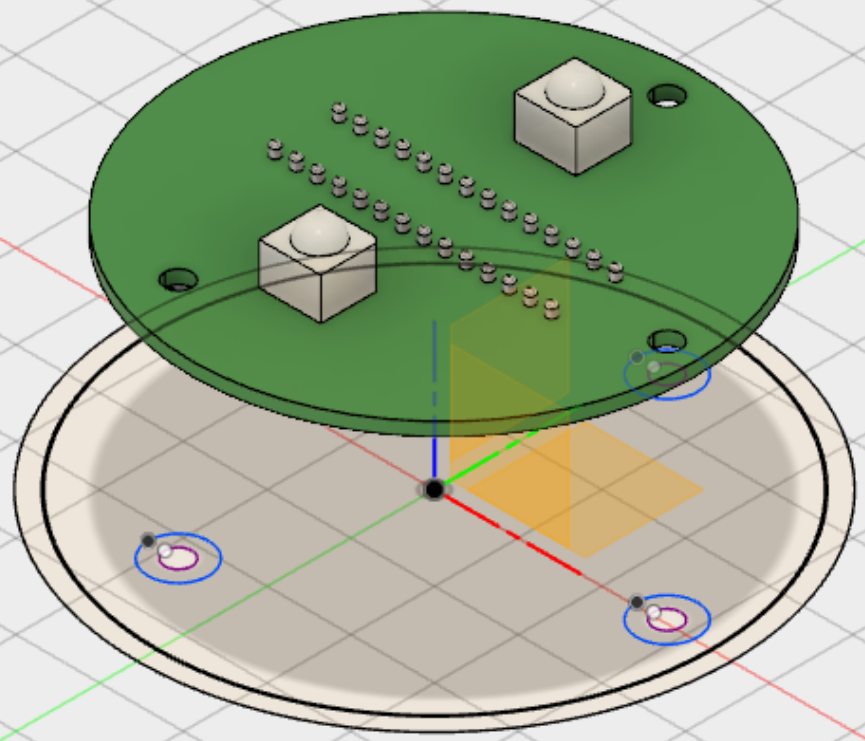
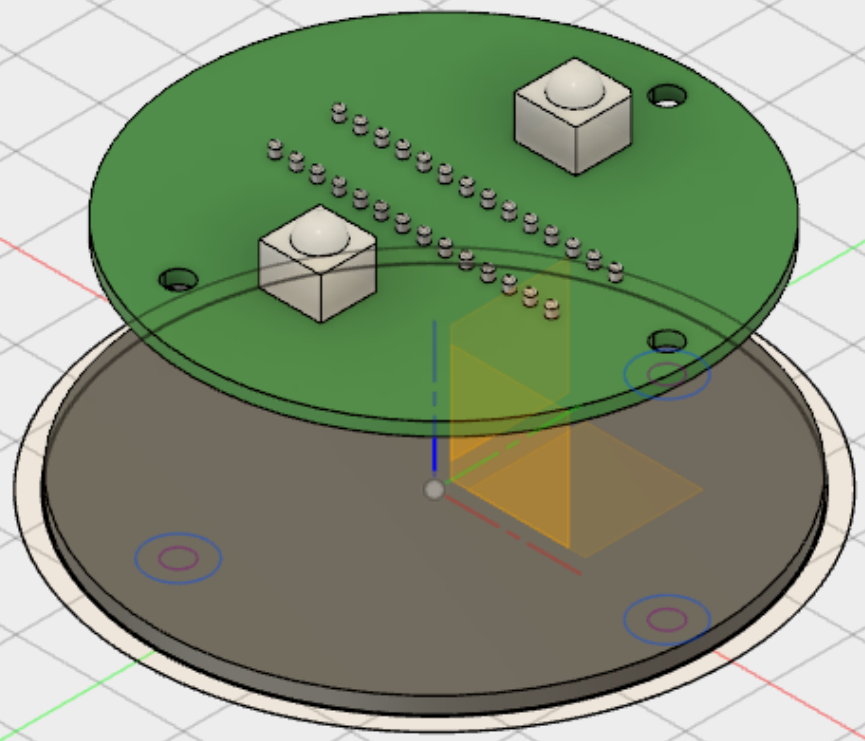
Bring the circuitry to the stage



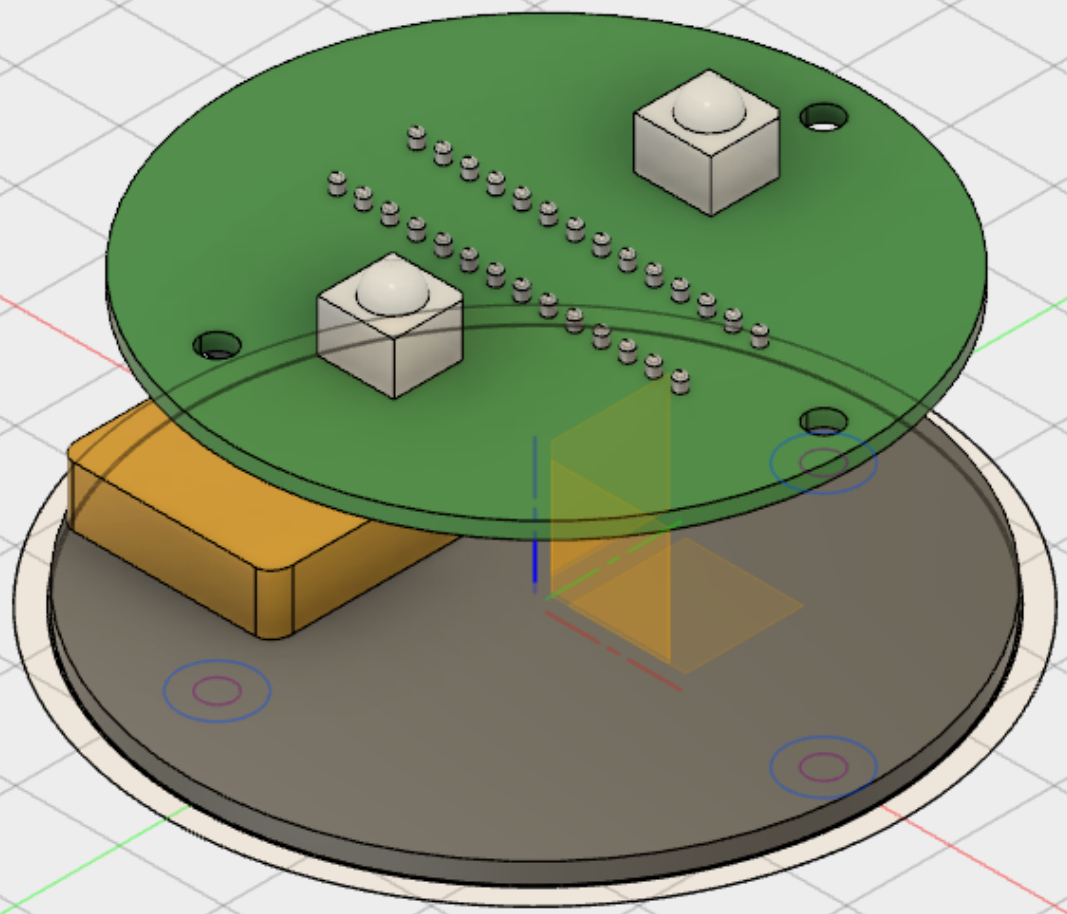
Move it to right location



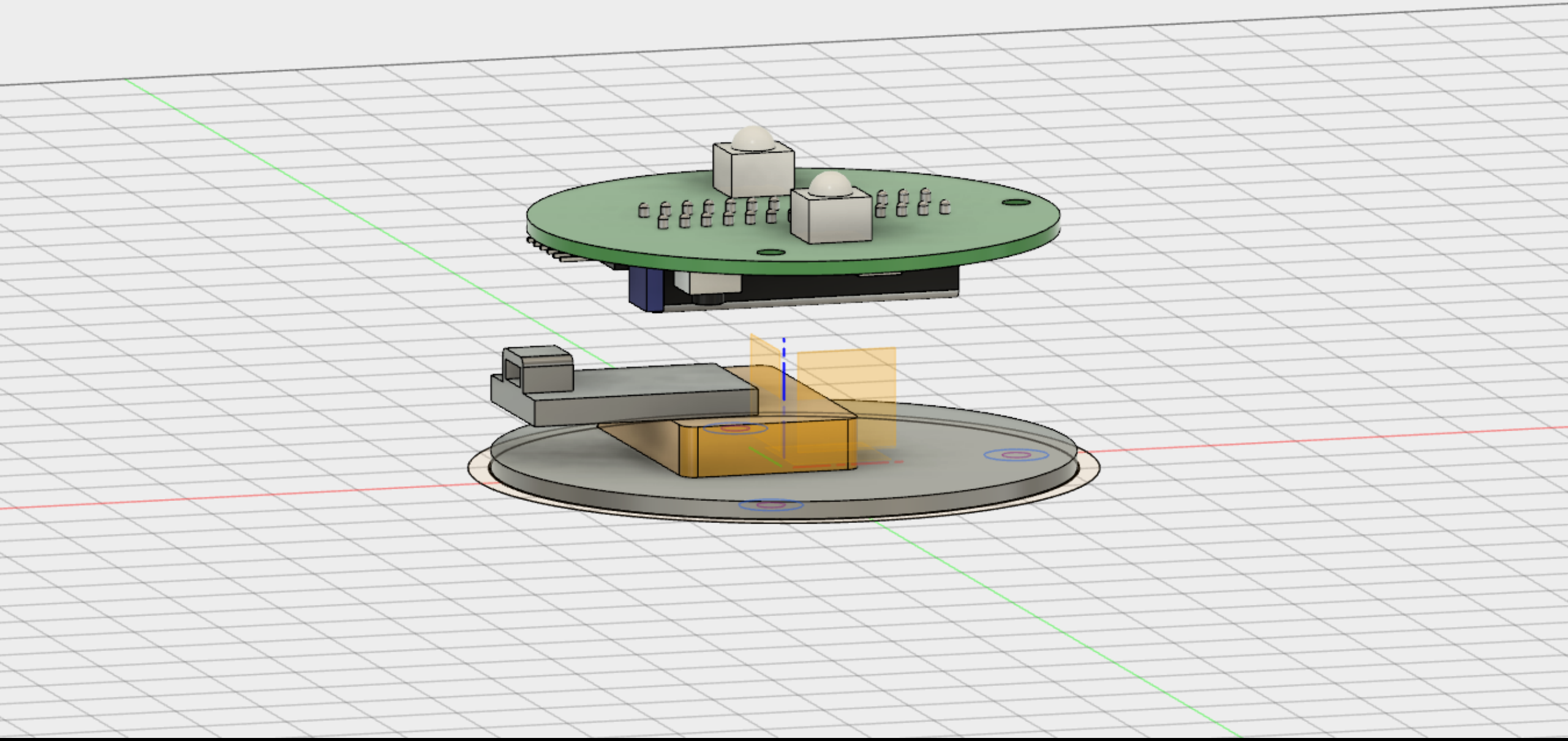
Extrude the base



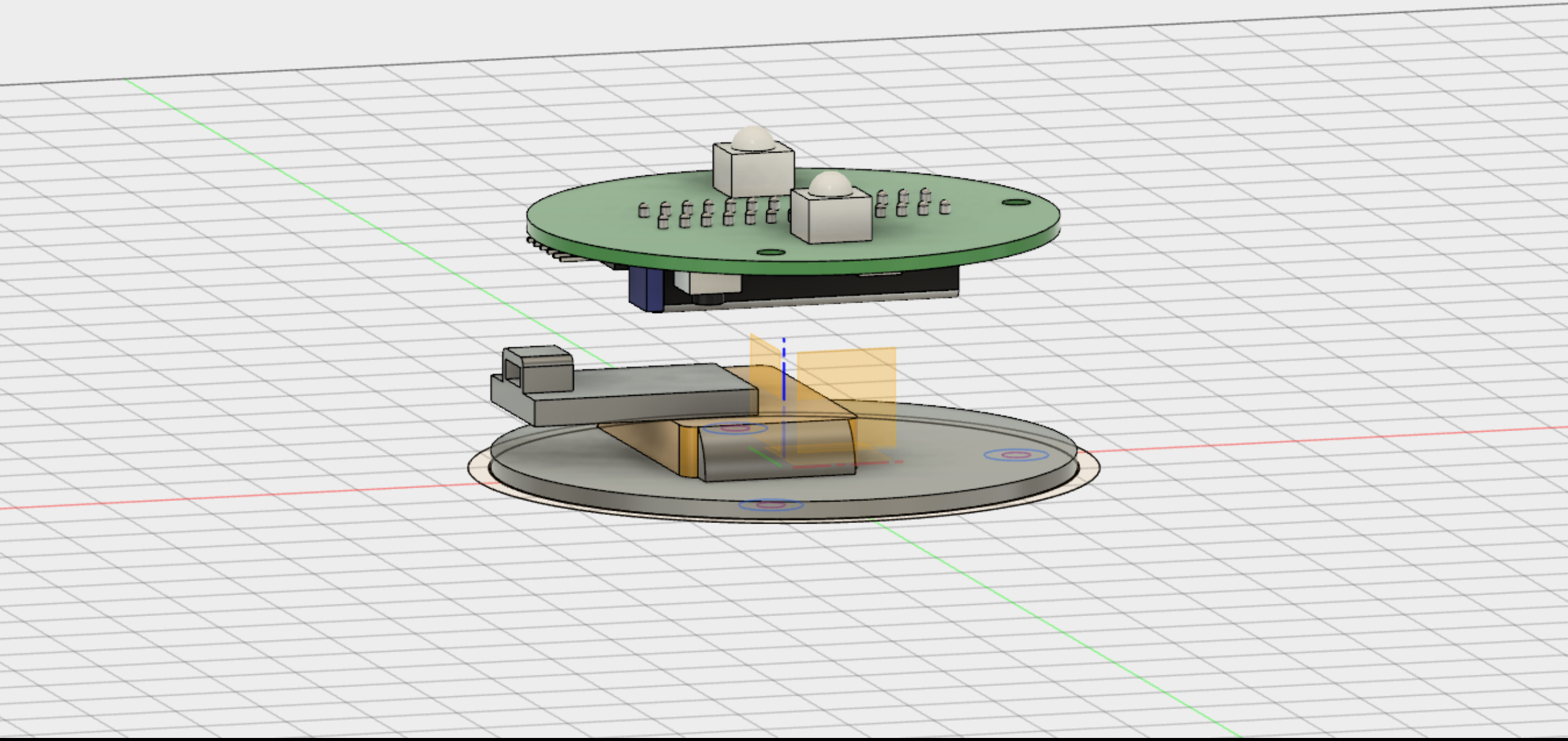
Place the Lipo Battery in place



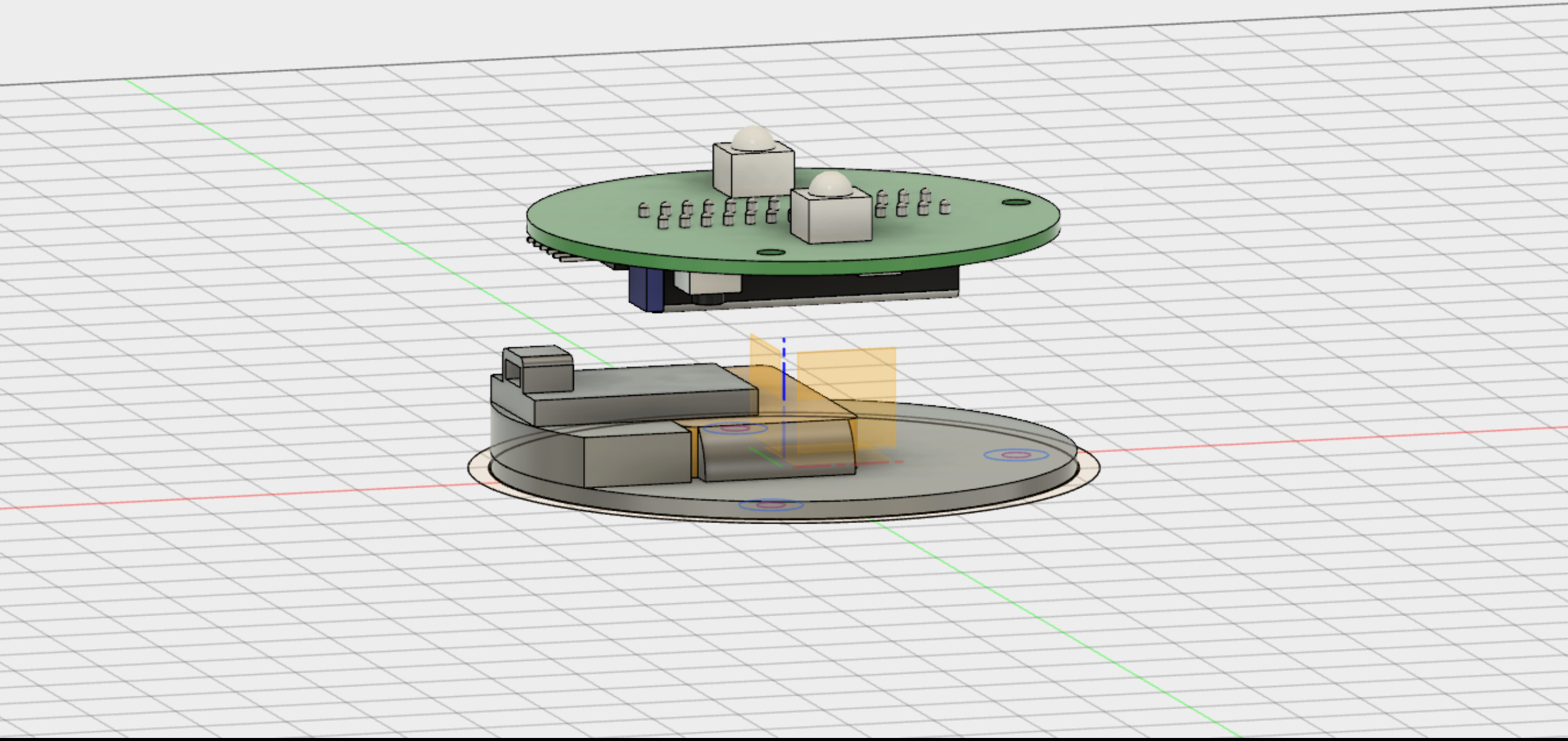
Place the TP4056 Lipo Charger in place



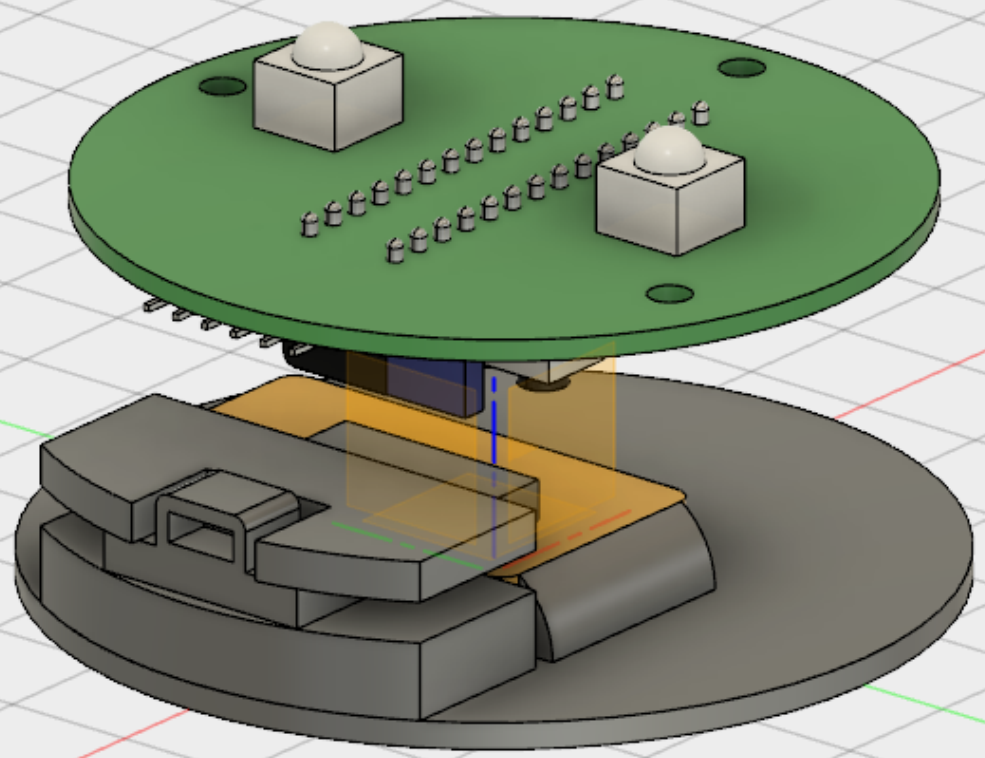
Exture a Battery Locker and apply fillet



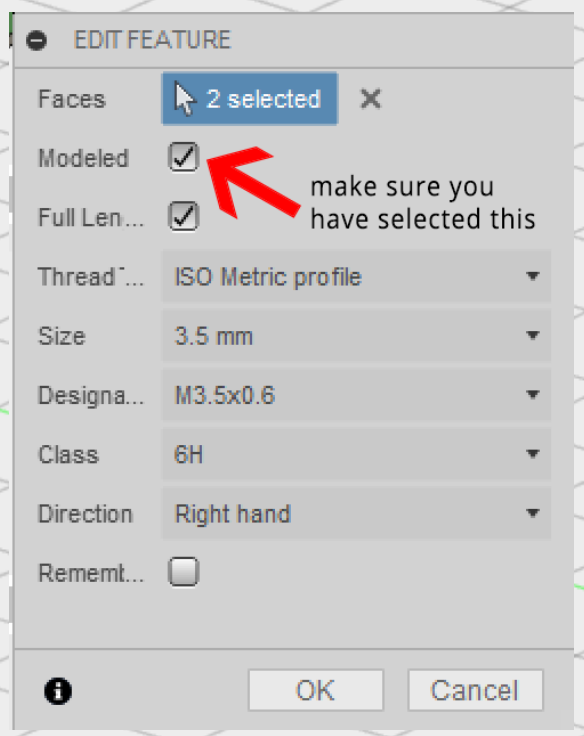
Design a raiser stand for TP4056 Lipo Charger

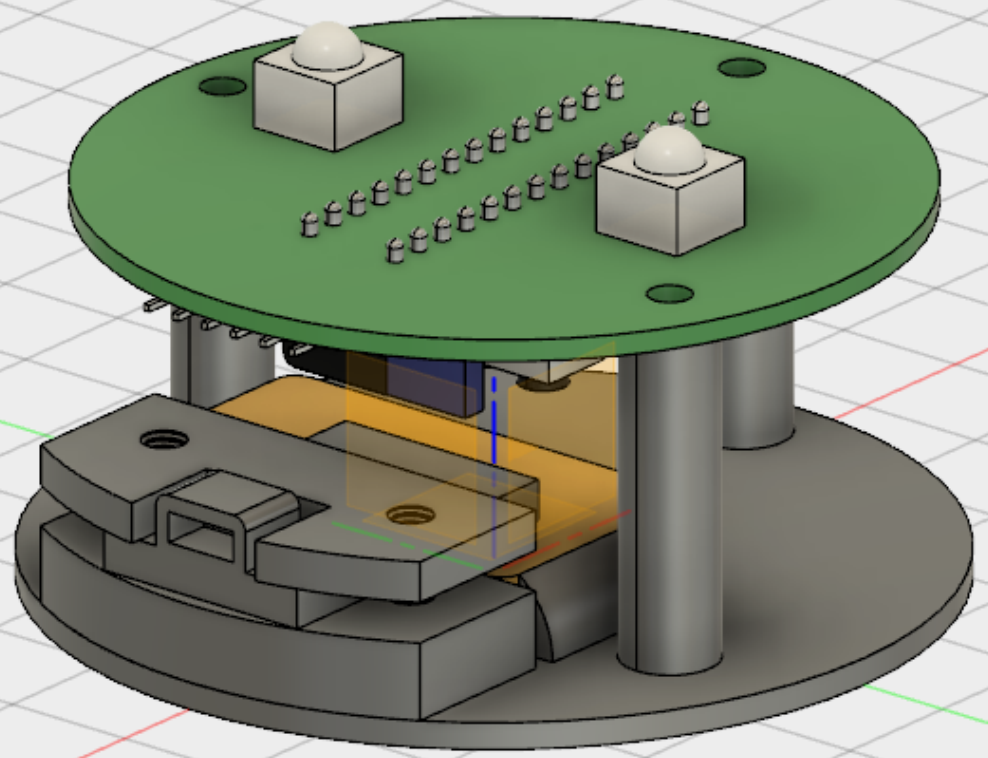


Design an upper locker for TP4056 Lipo Charger

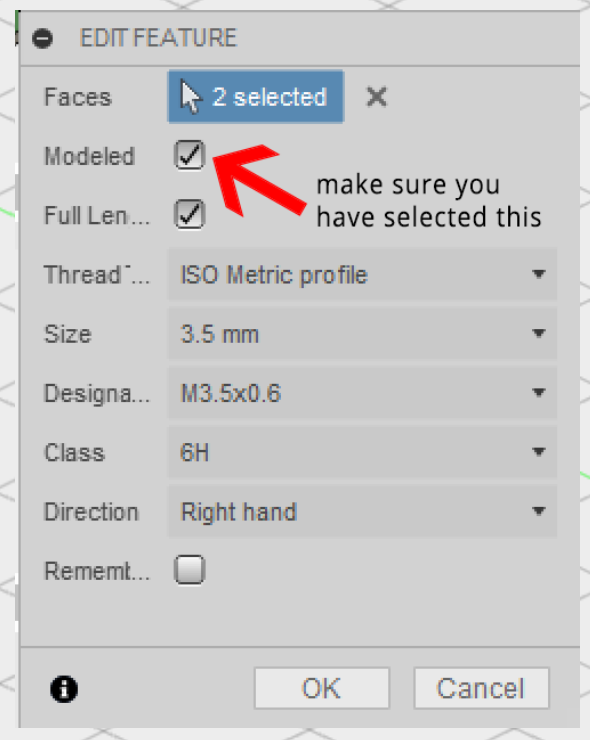


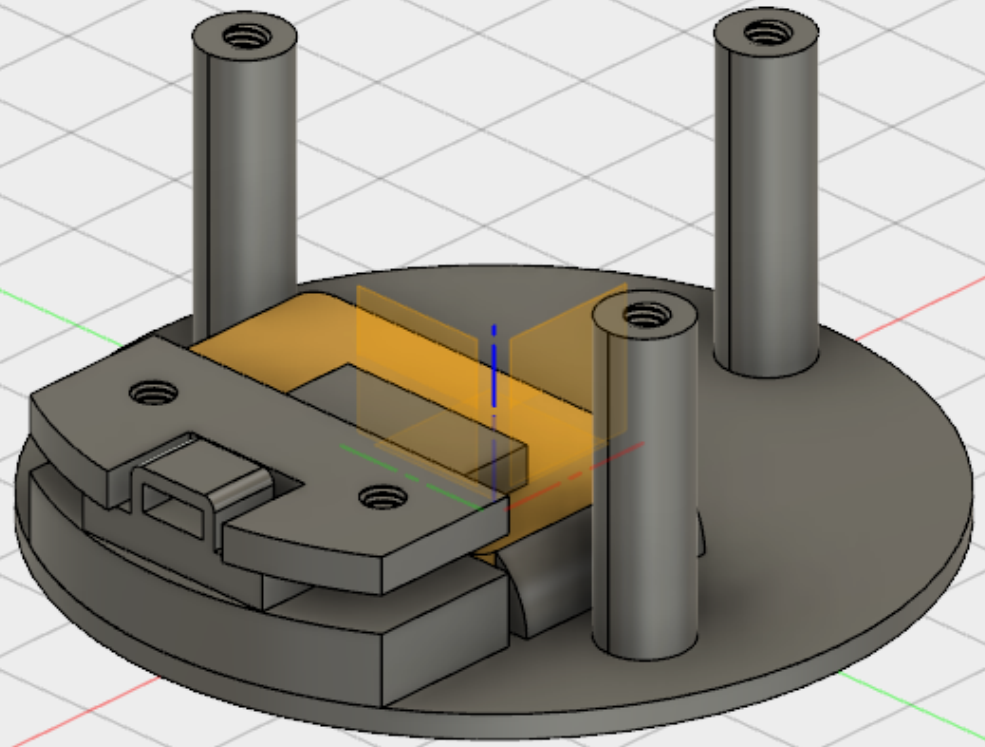
Create holes and establish a thread (3.5mm) on the upper locker



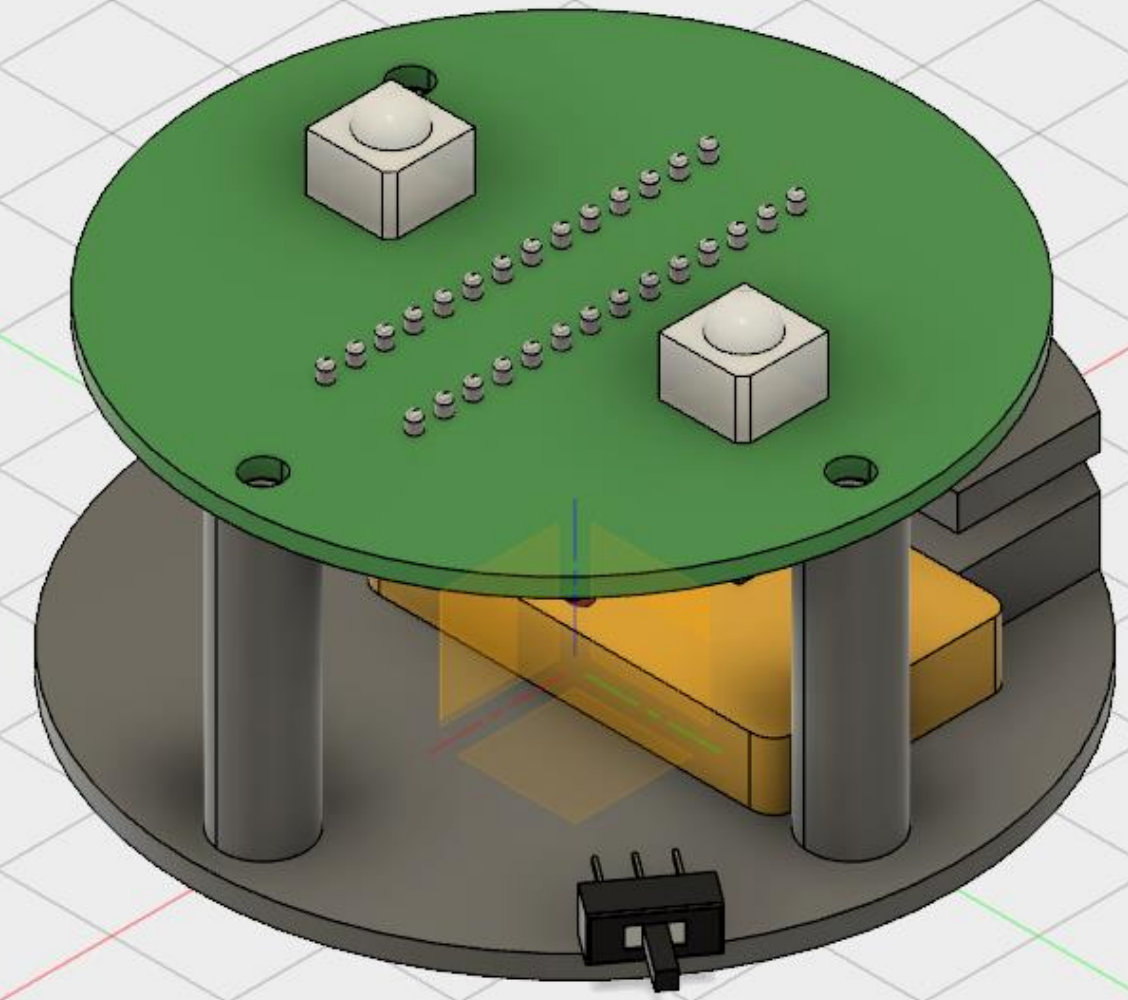


Extrude the three standing legs and prepare threads (3.5 mm) in them

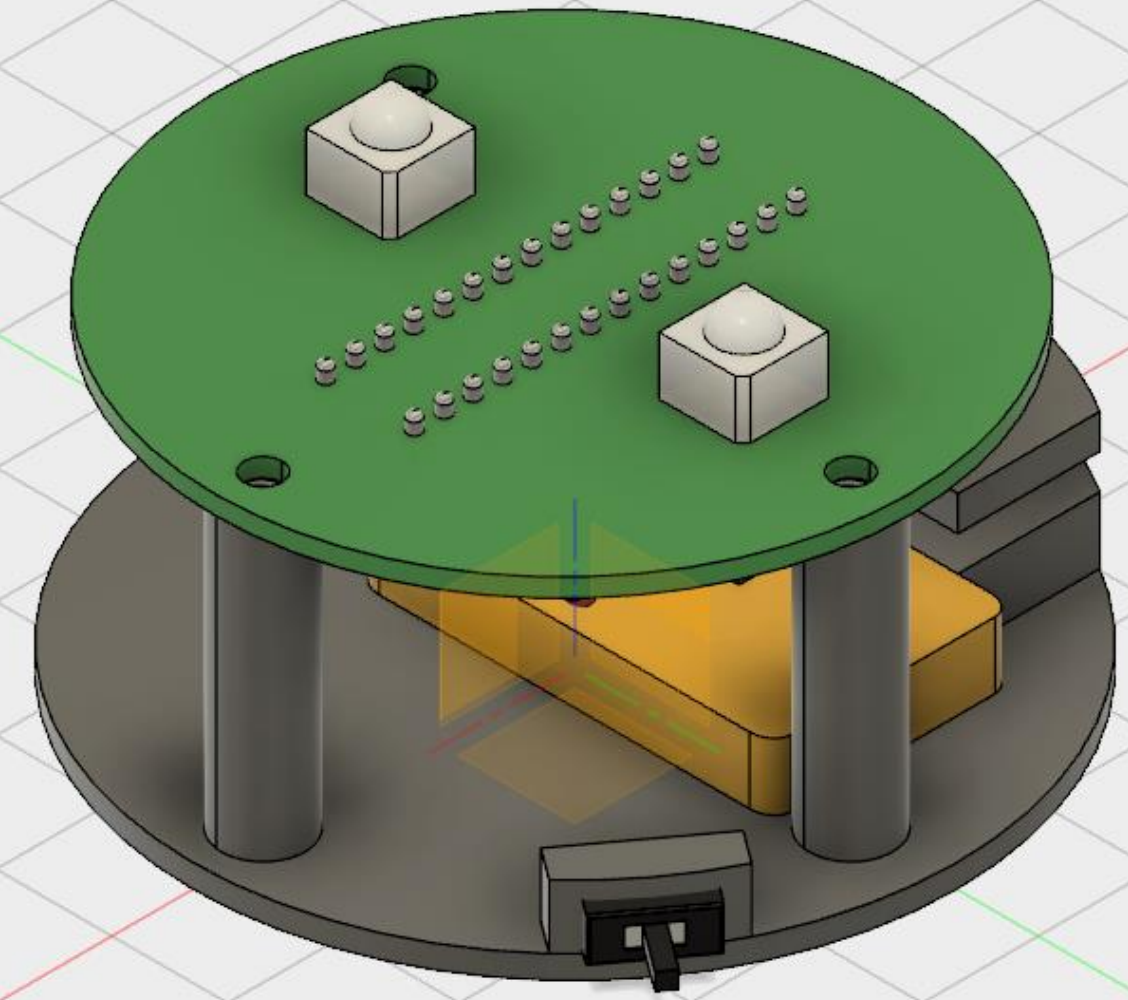




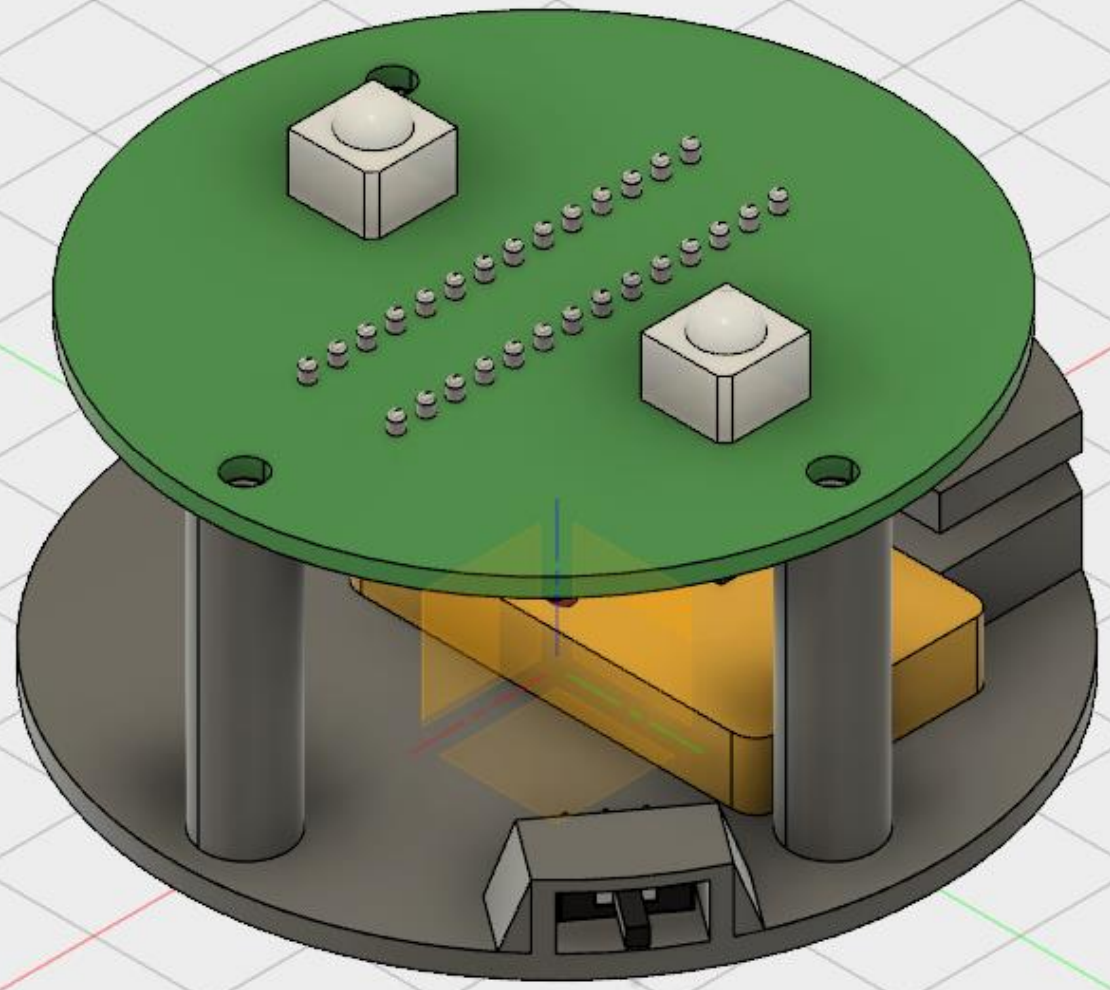
Insert the slide switch and place it accordingly



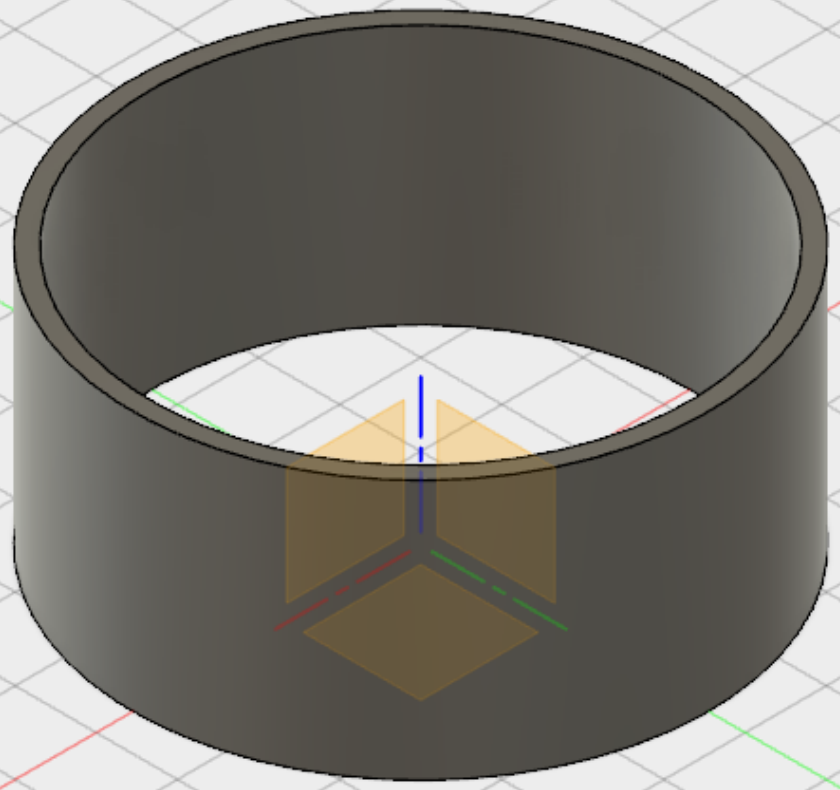
Create a housing for the slide switch

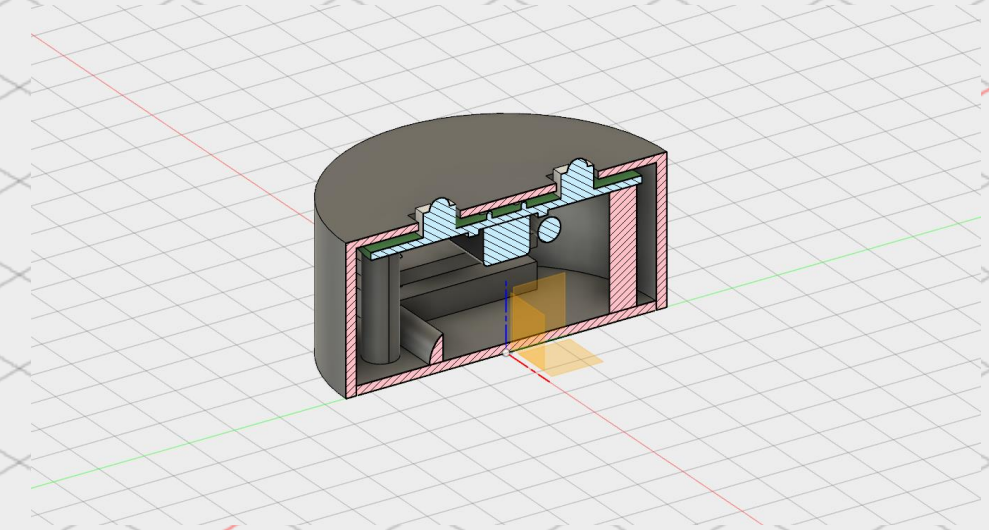


Fine tune housing details

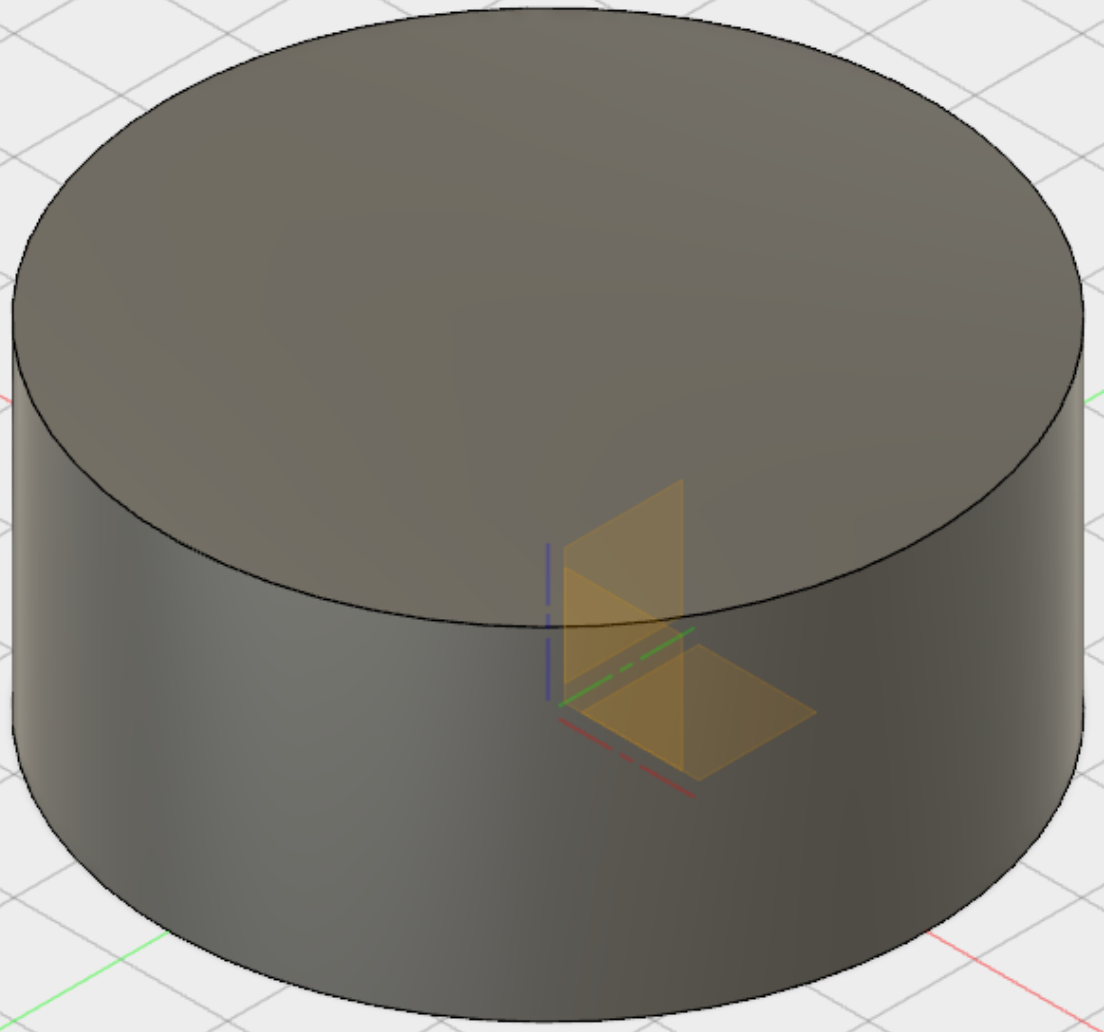


Create a shield for the top enclosure
Apply a section analysis to see the interior

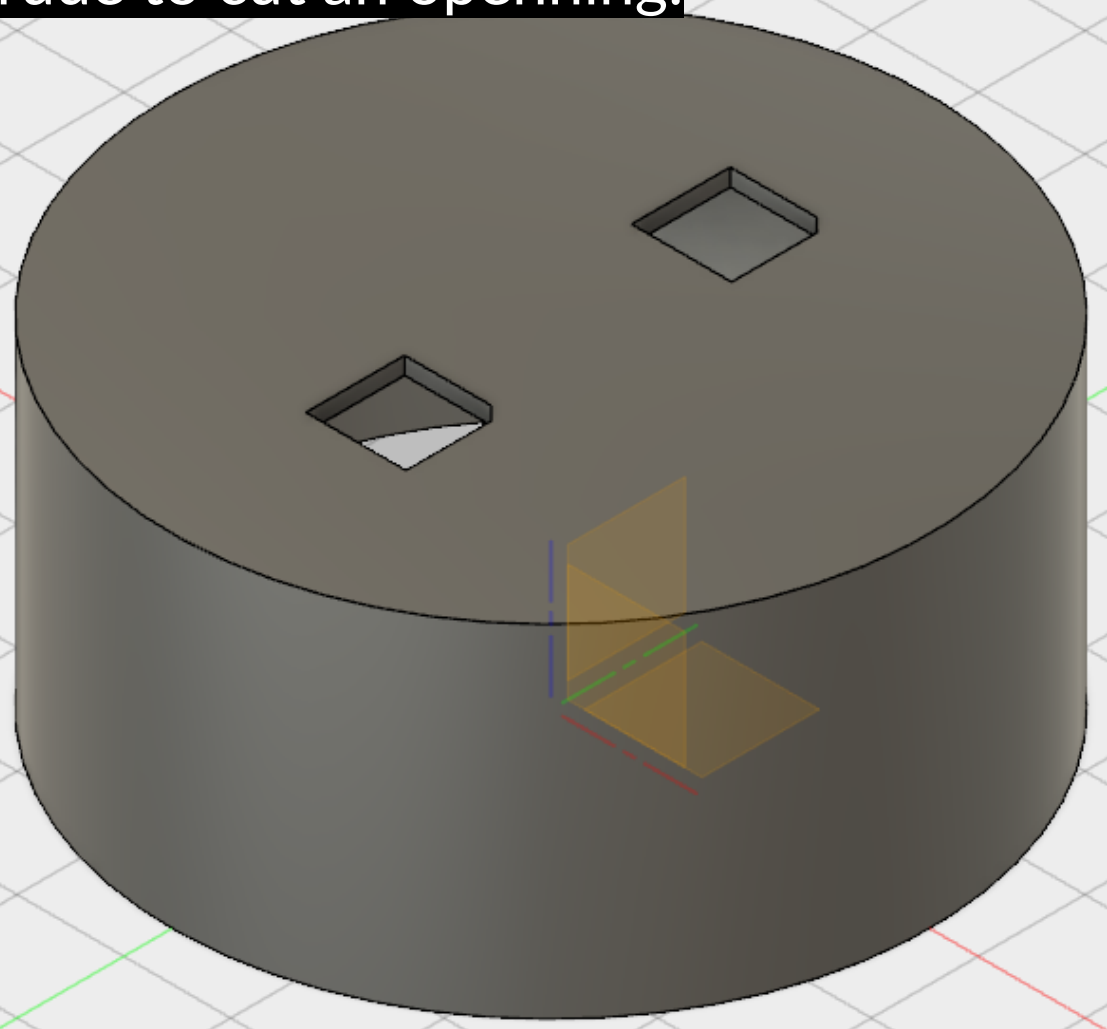




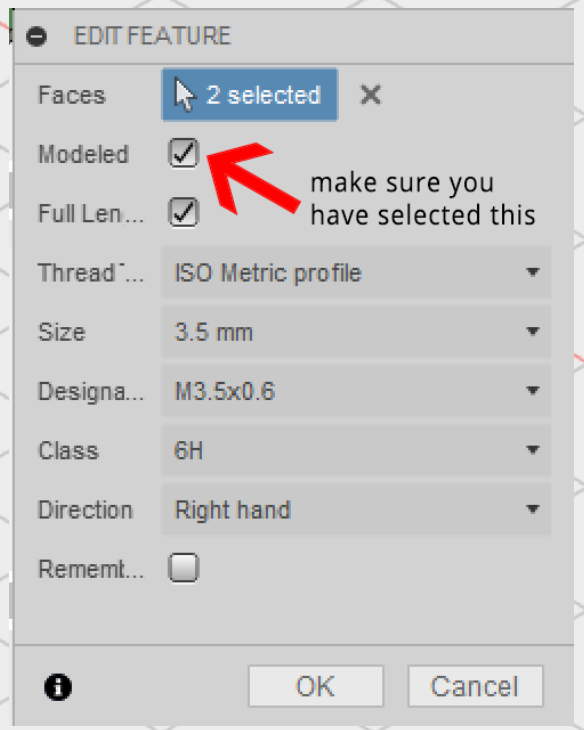
Cover the top

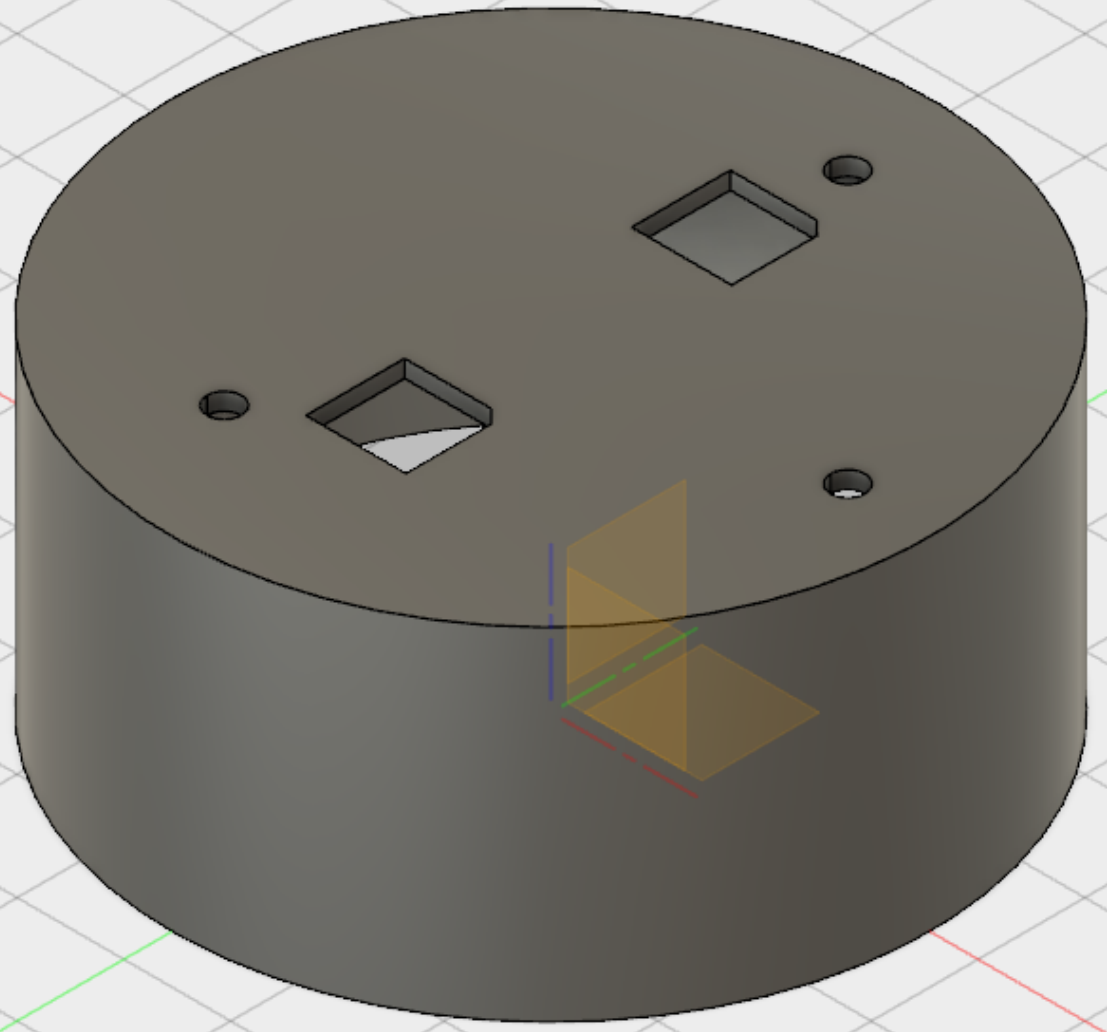


Map the led sketches on to the surface of the top enclosure
Outline 0.5 mm and extrude to cut an openning.

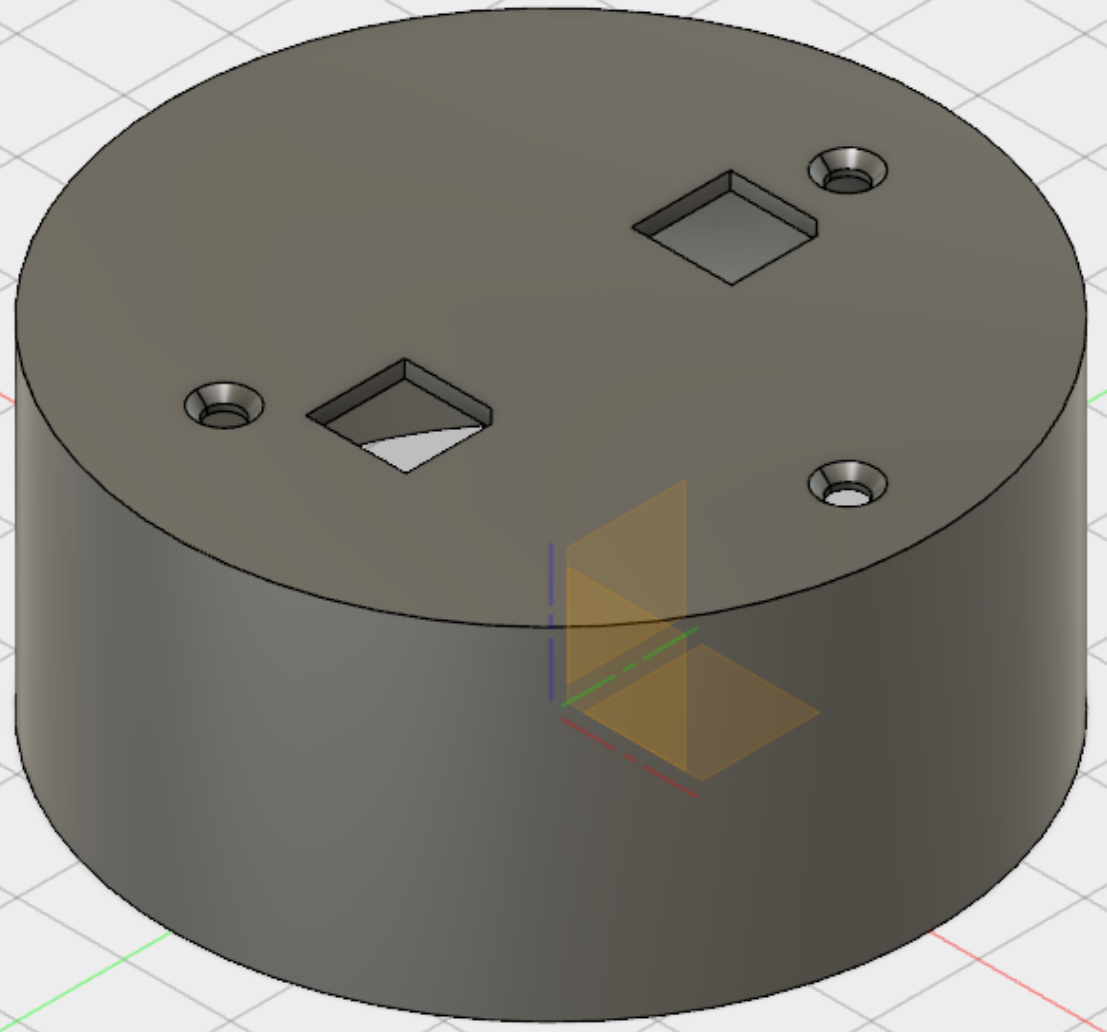


Map the Circuit thread circles and exture to cut holes

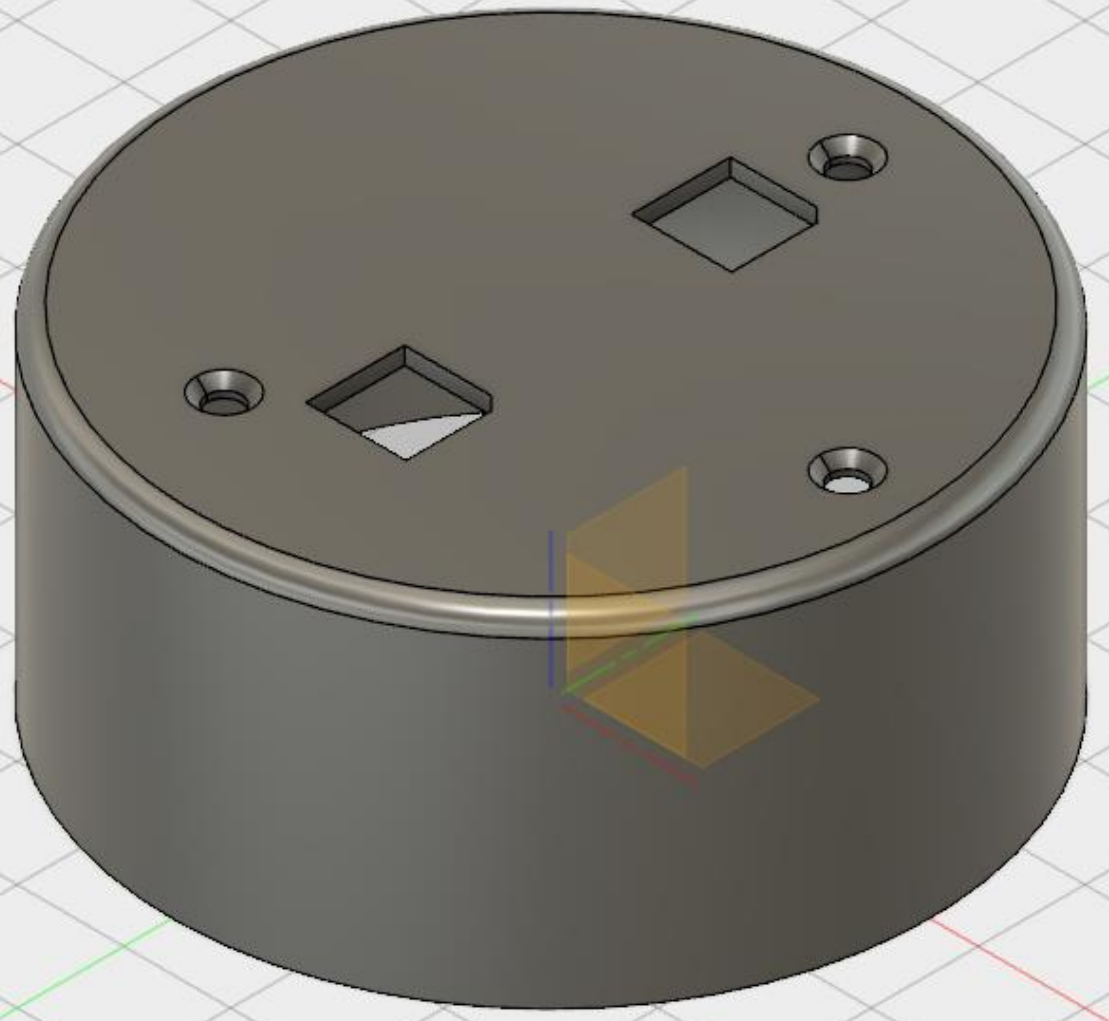




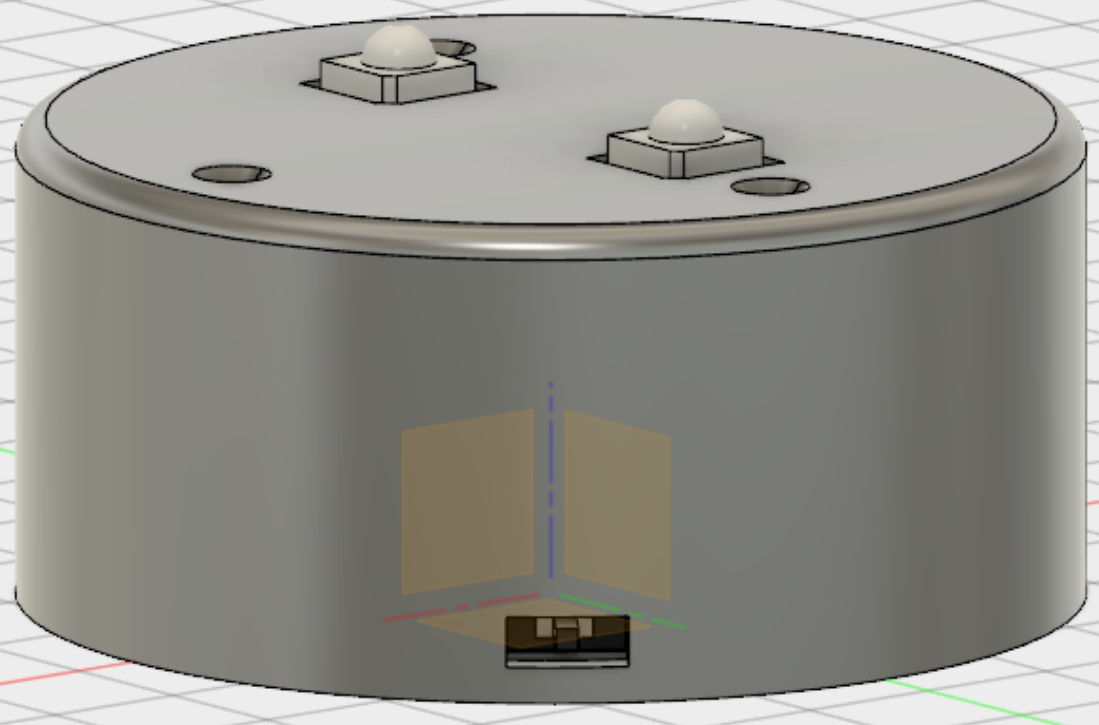
Apply chamfer to let the threads go seemlessly



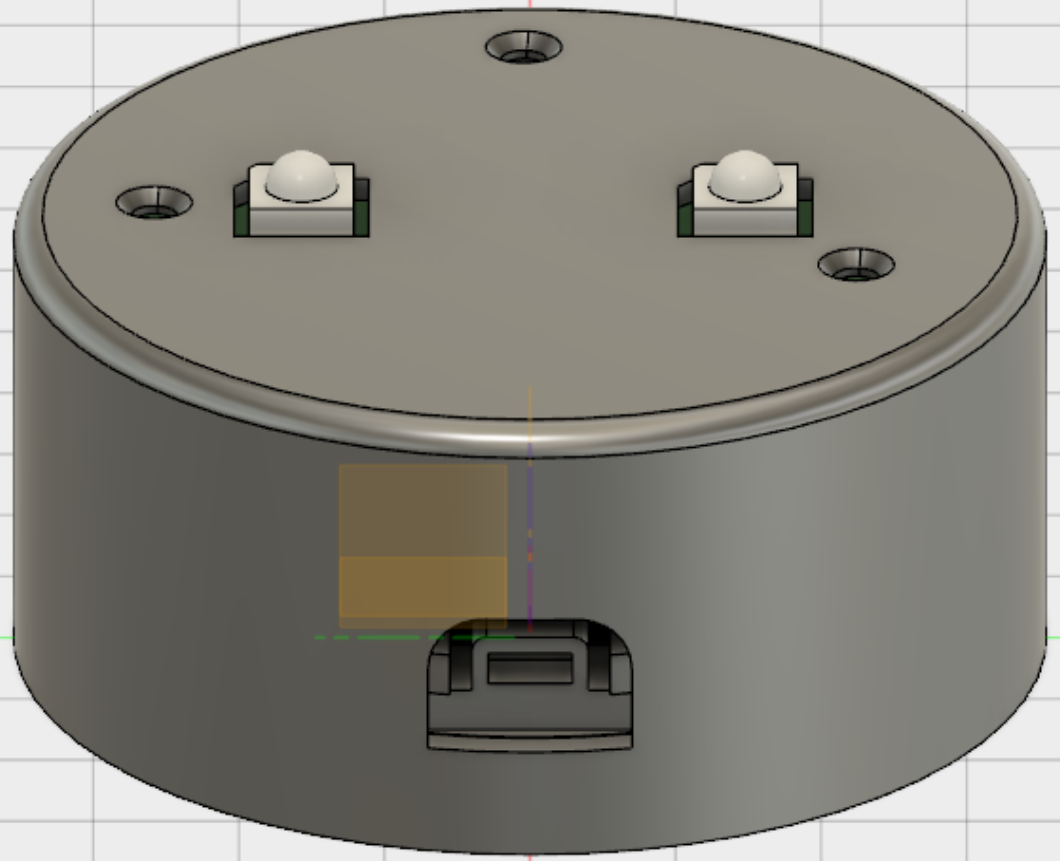
Apply fillet to give the case a soft touch



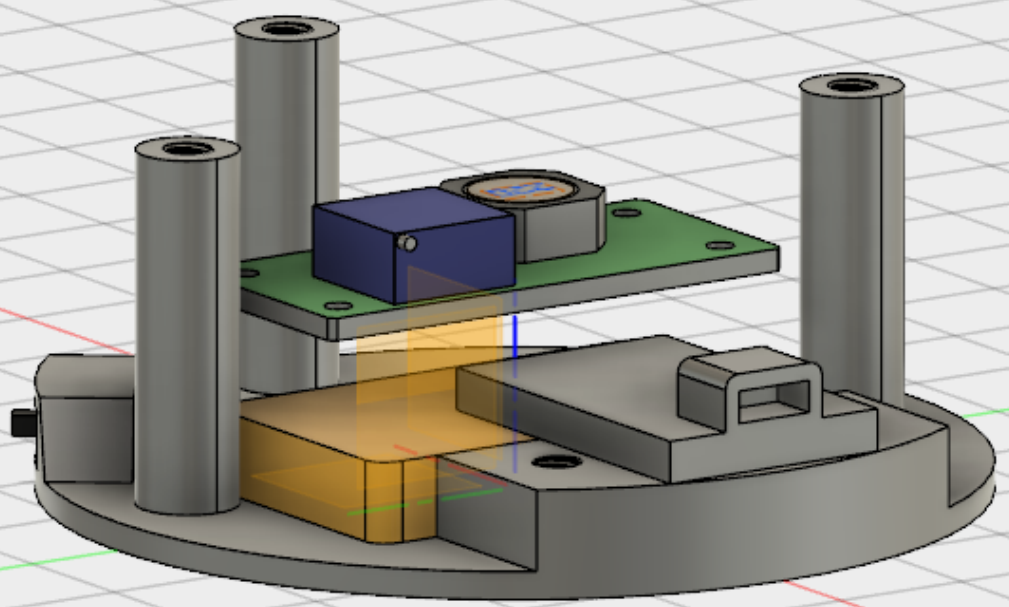
Create a hole for reaching the slide switch control



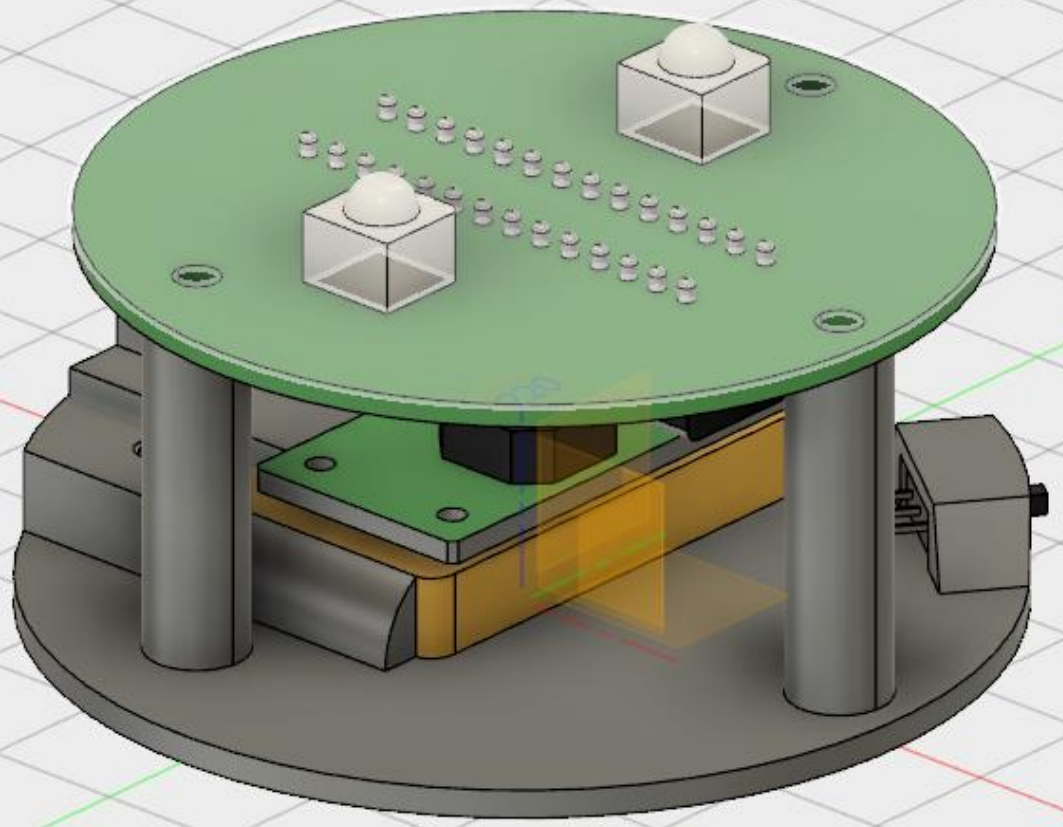
Create a hole for reaching the Lipo Charging USB input powering



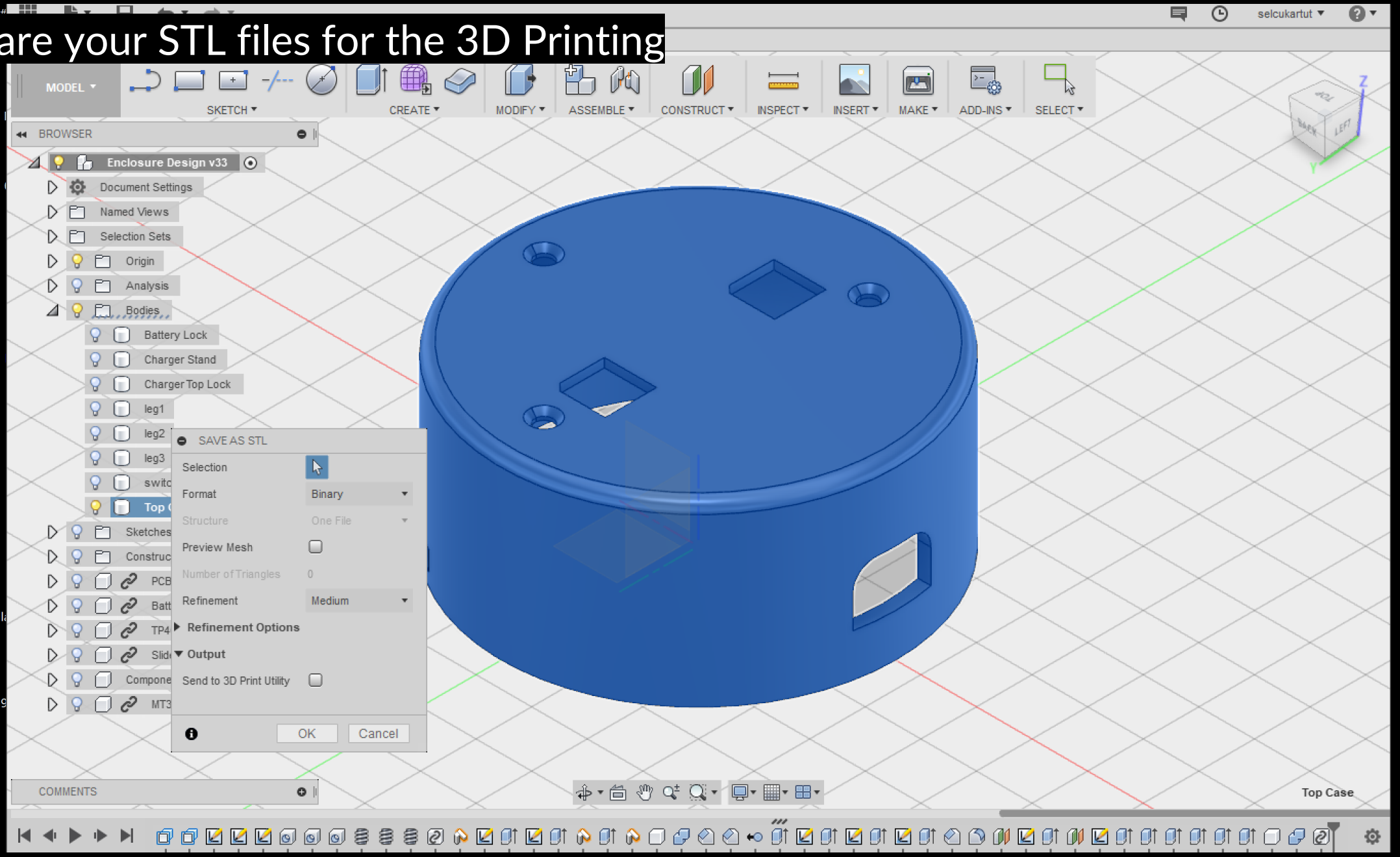
Bring the MT3608 booster to the stage
This component will not be attached to any surface at all



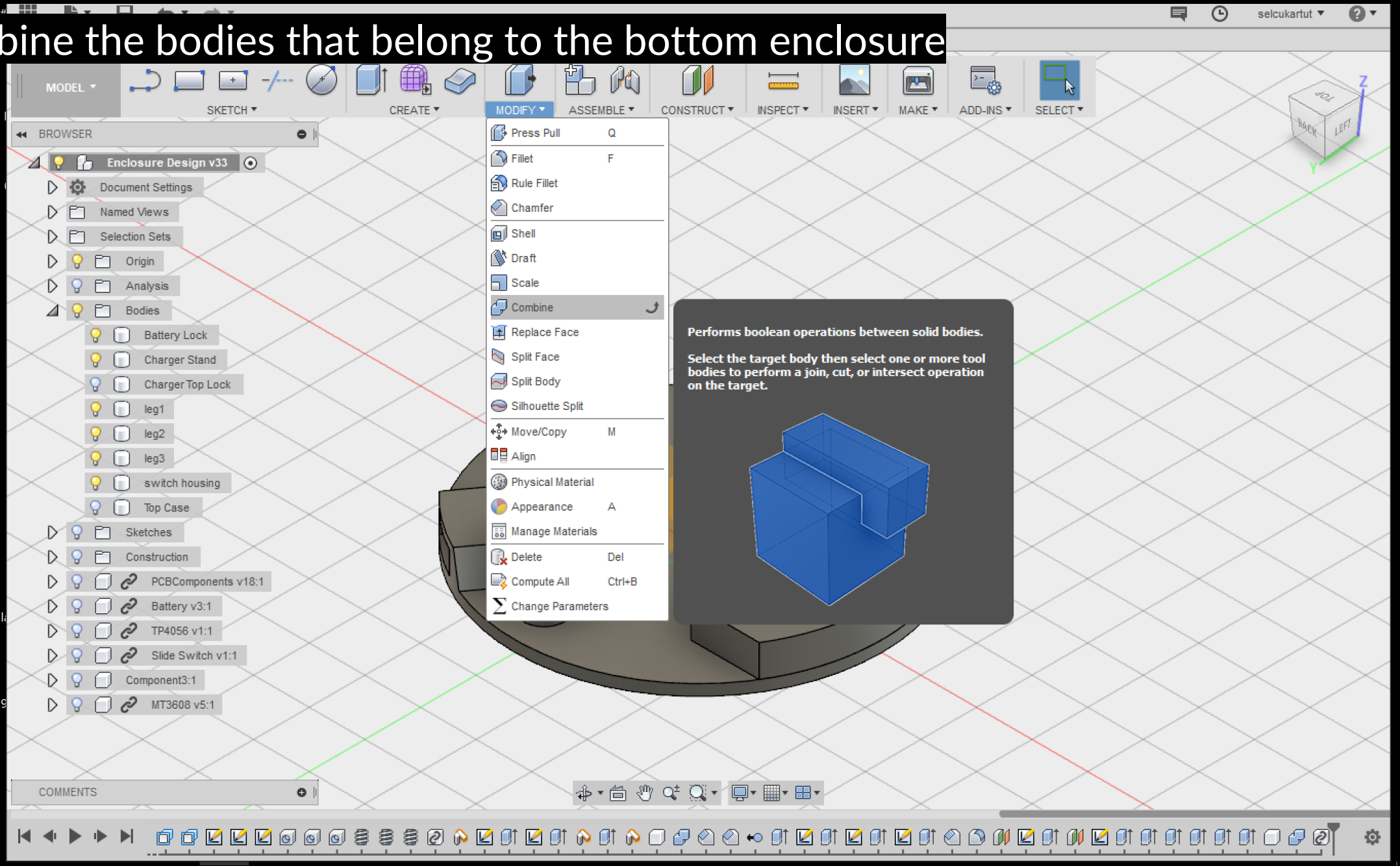
Your design should look something similar to the below



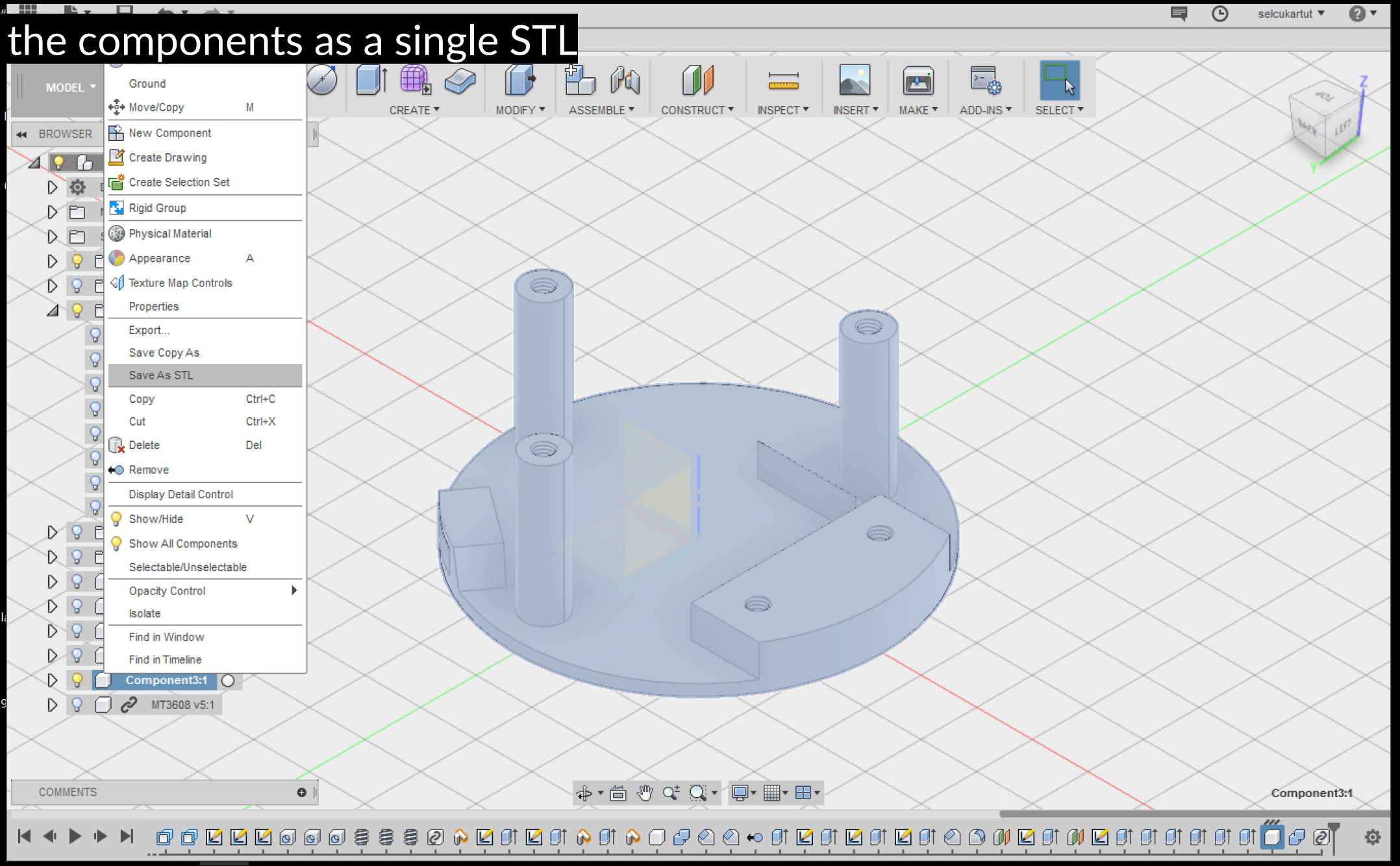
Prepare your STL files for the 3D Printing



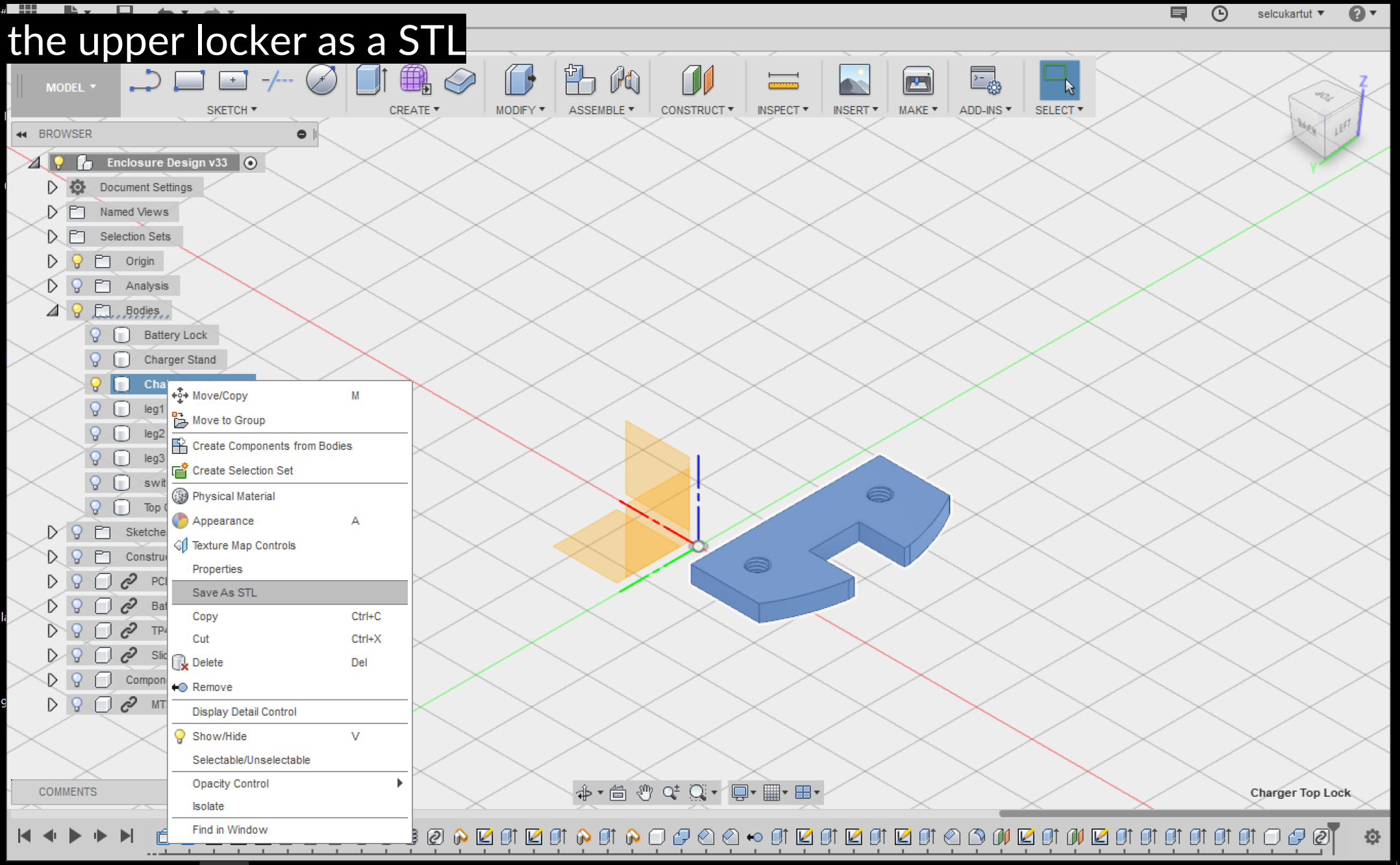
Combine the bodies that belong to the bottom enclosure



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/)

Rechargeable

Lead Acid Gel

Lithium-ion (Li-ion)

Nickel-Cadmium (NiCd)

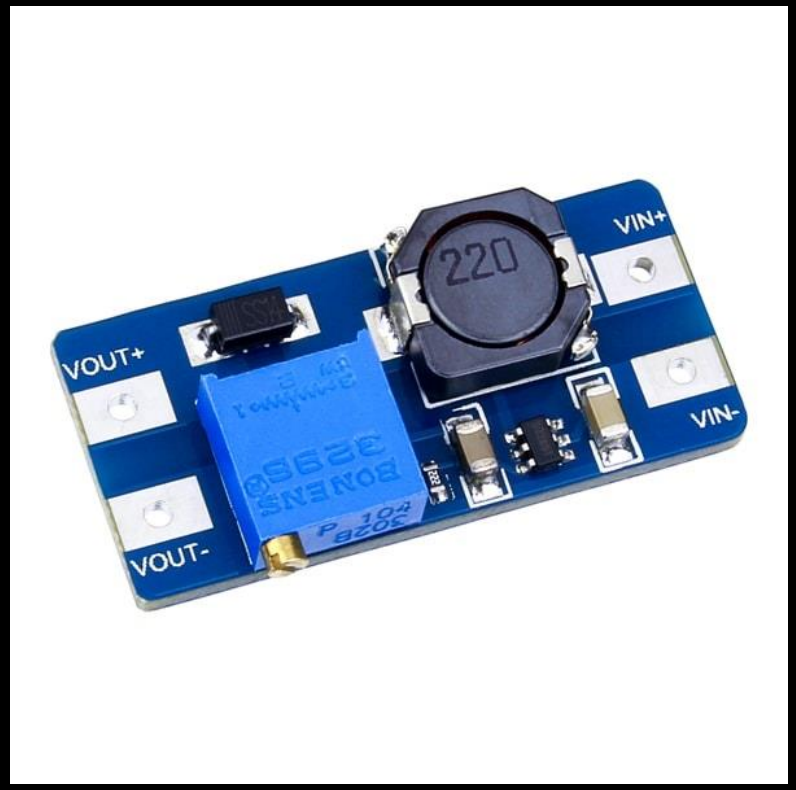
Nickel Metal Hydride

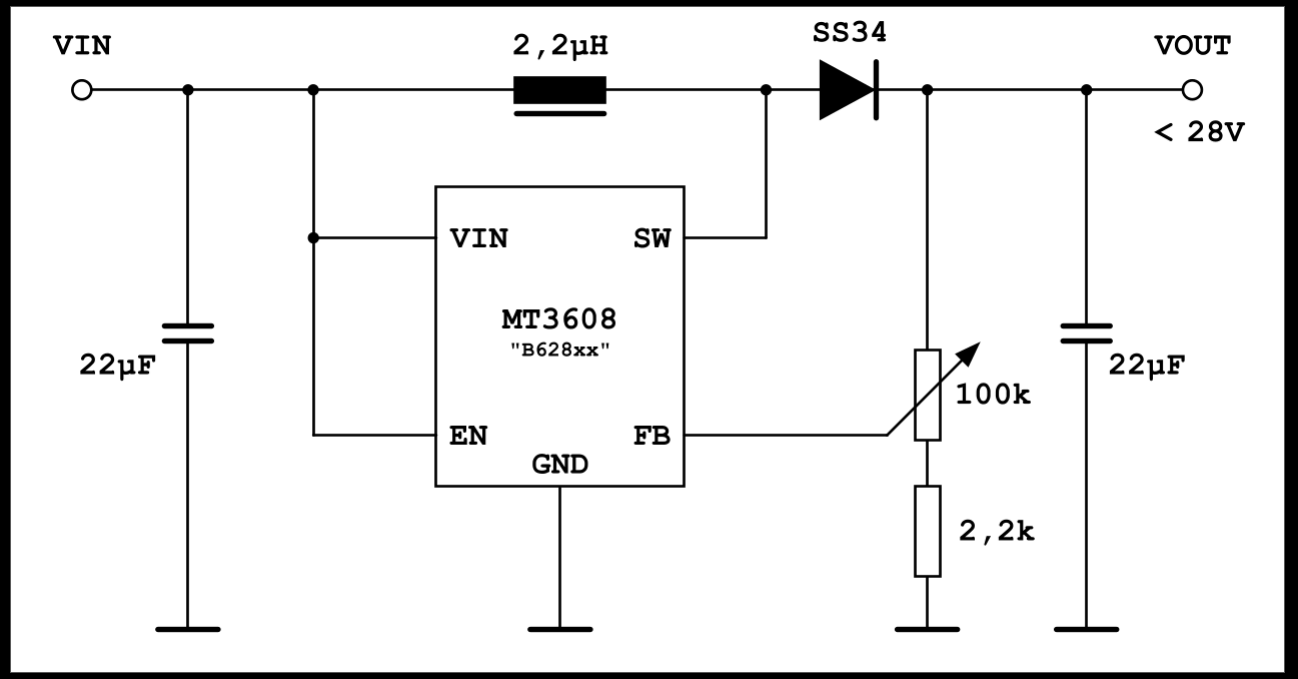
Wiki : A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated as LiPo, LIP, Li-poly, lithium-poly and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid one.

Powering Arduino with a Lipo Battery

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

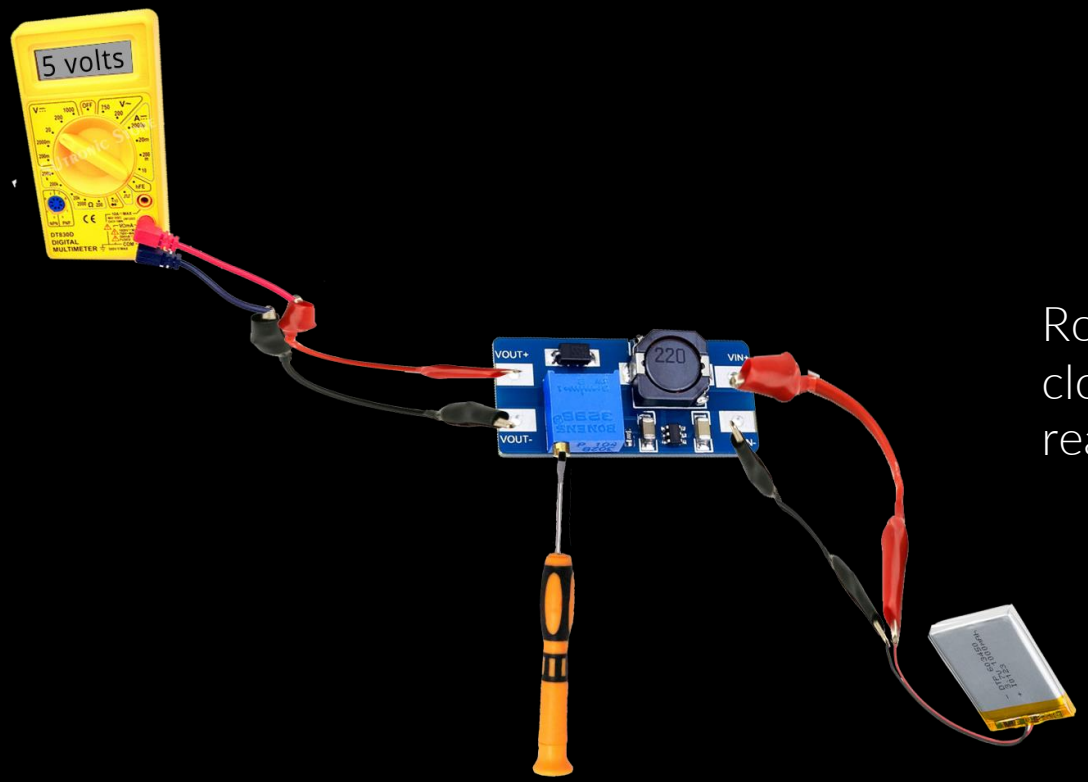
We will use MT3608 - The MT3608 is a constant frequency, 6-pin SOT23 current mode step-up converter intended for small, low power applications. Boost = Output Voltage has to be higher than input voltage





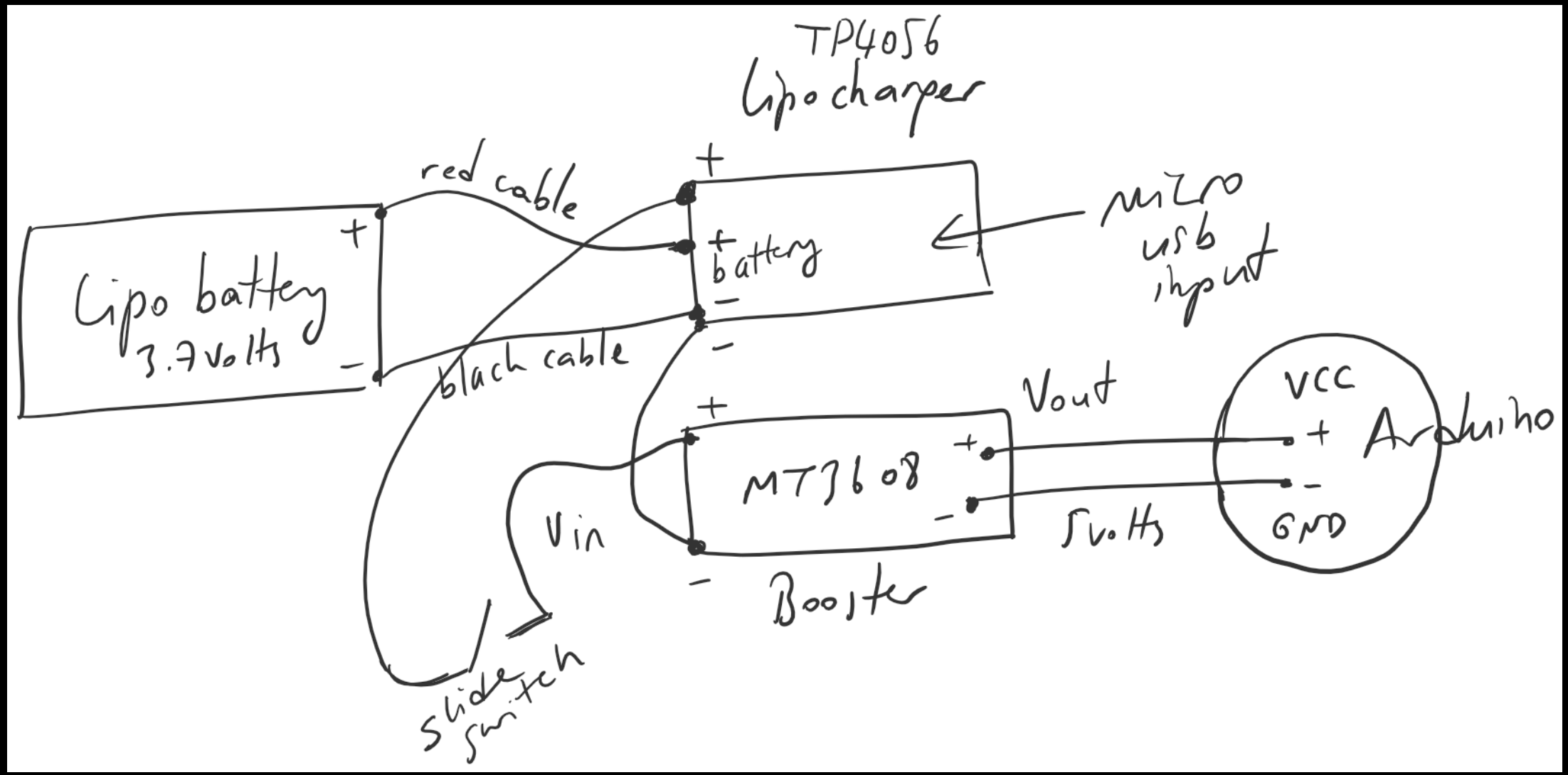
Adjusting the Required 5 volts boosting (Do this before connecting to Arduino)

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

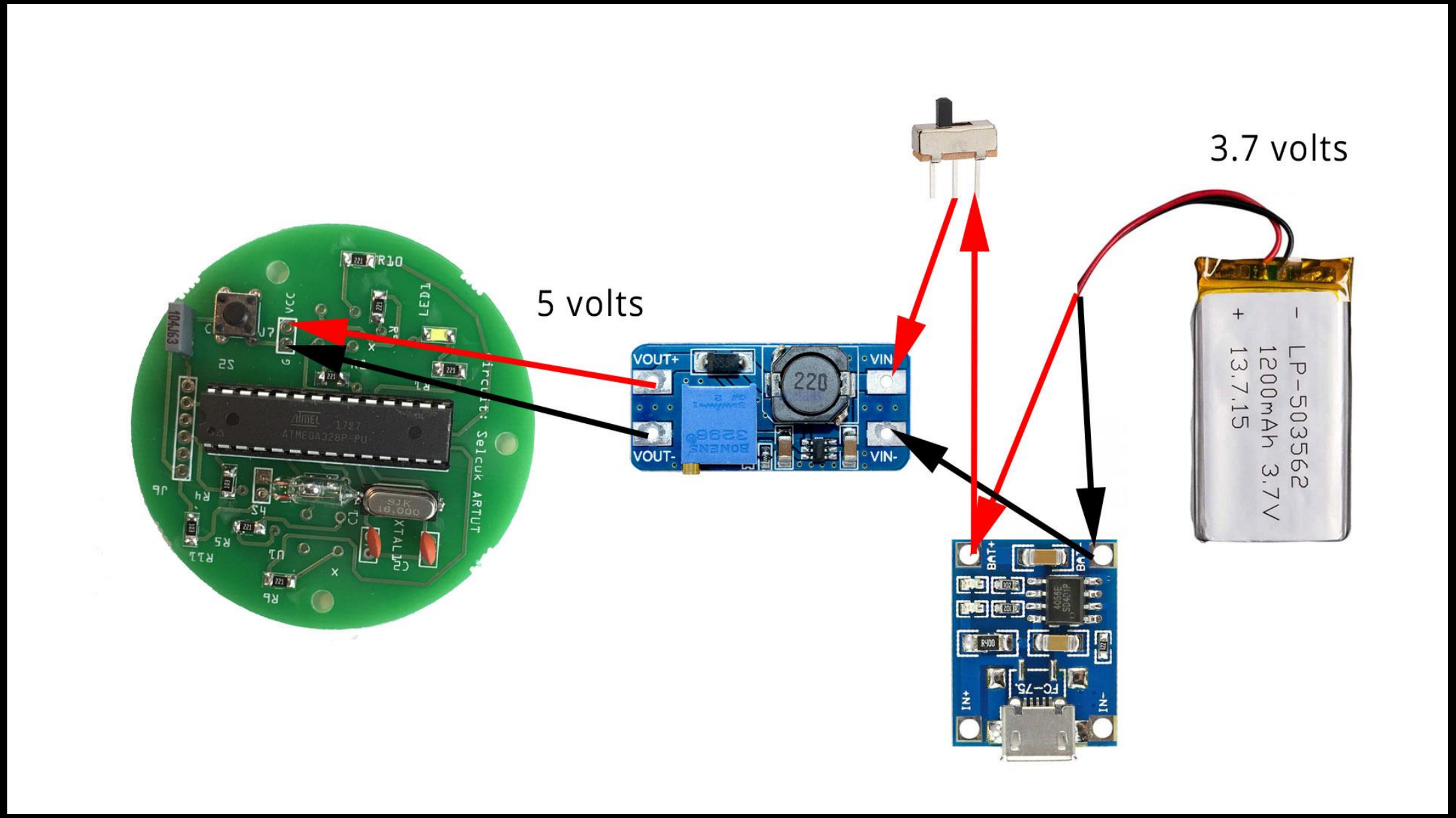


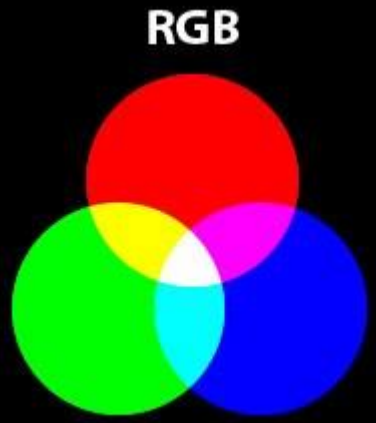
Rotate the small potentiometer untill you get a reading close to 5 volts. I recommend you to tune the reading slightly below 5, such as 4.96-97 etc

Wiring all parts together



Wiring all parts together





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