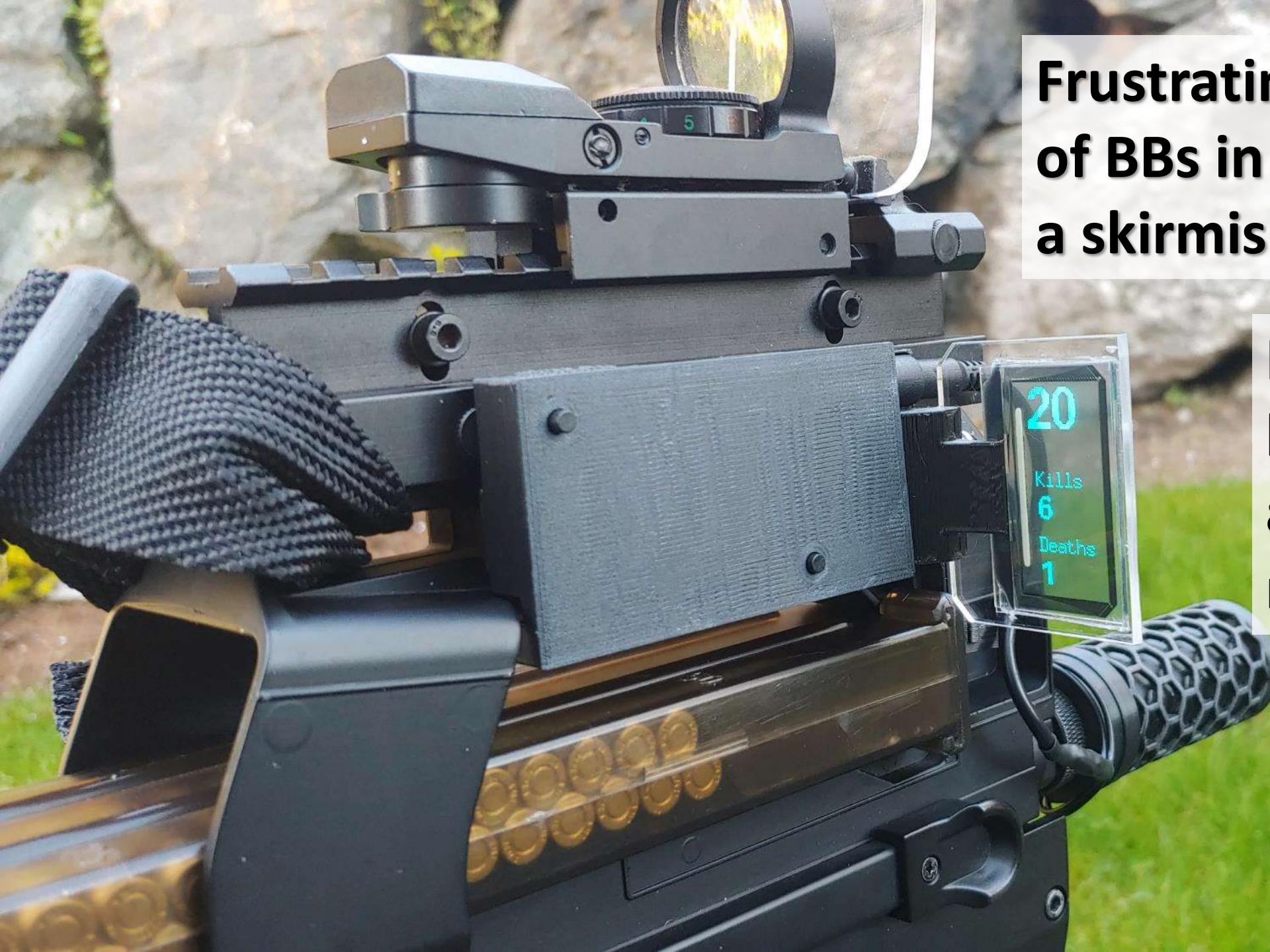


# Airsoft HUD

## For P90





**Frustrating to run out  
of BBs in the middle of  
a skirmish**

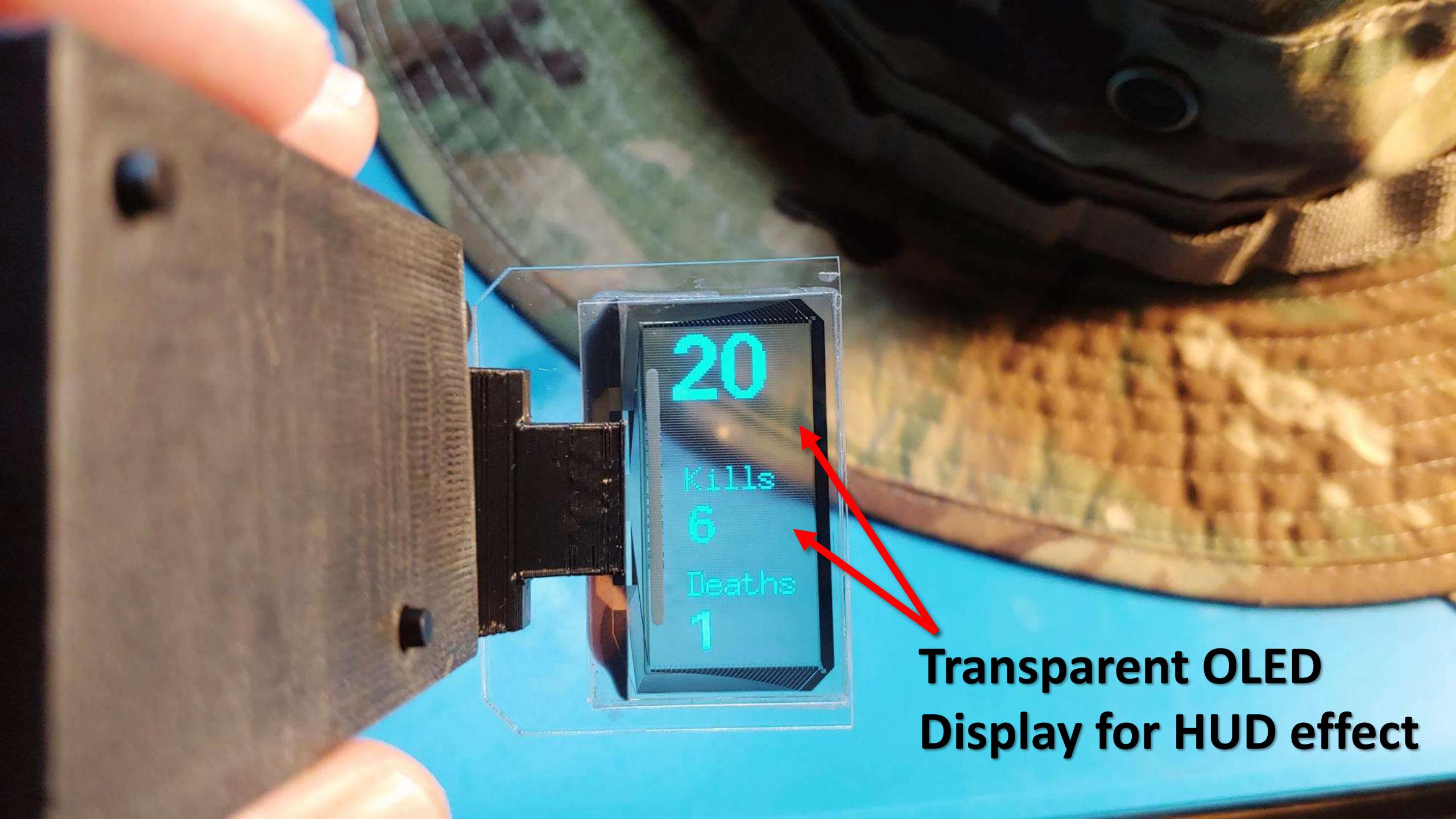
**HUD shows  
how many BBs  
are left in the  
magazine!**



BBs left in magazine

Times you shot someone

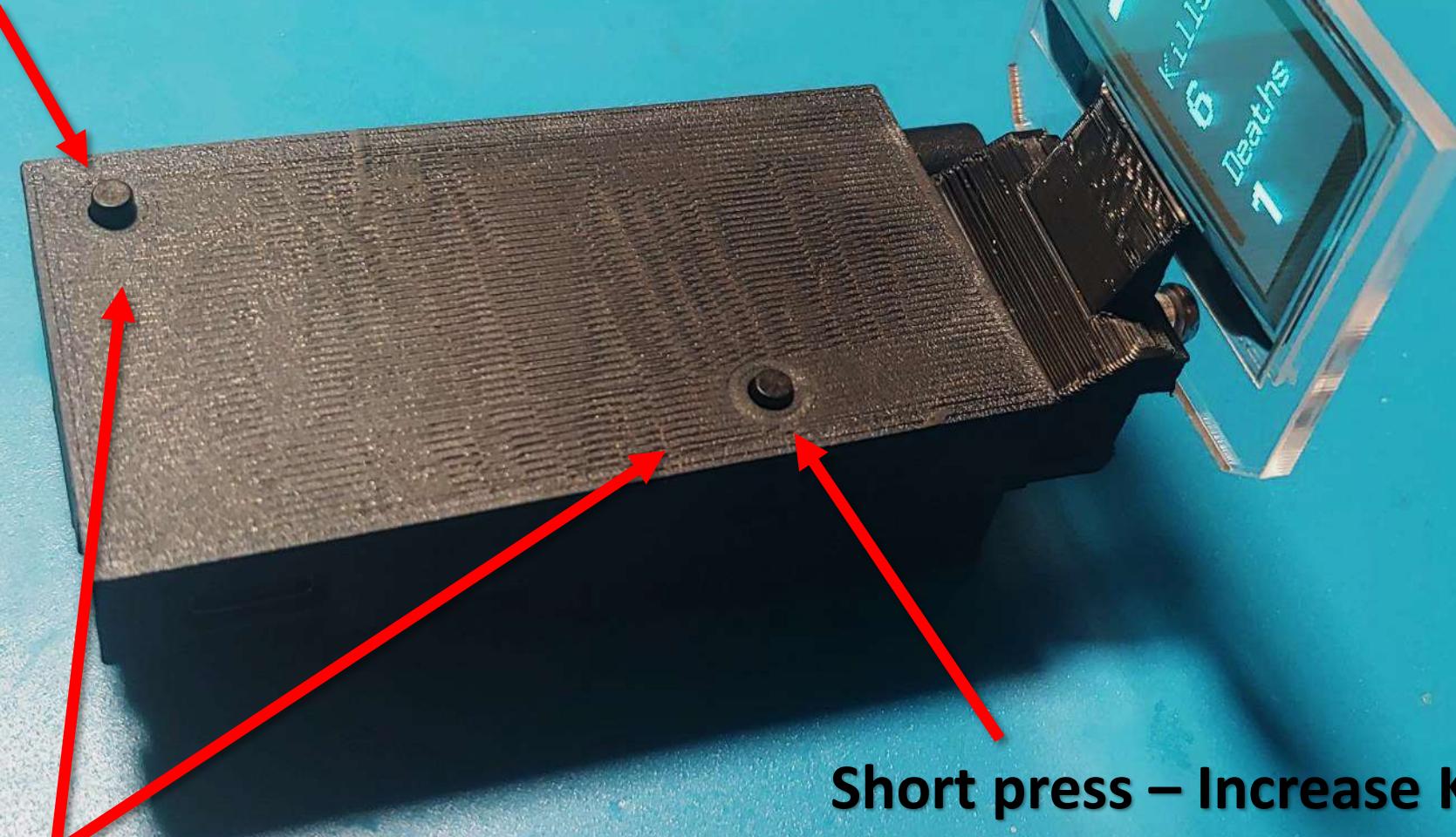
Times someone shot you



**Transparent OLED  
Display for HUD effect**

**Short press – Increase Deaths**

**Long press 2 seconds – Reset Kills/Deaths**



**Simultaneous press – Reset BBs count**

**Short press – Increase Kills**

**Long press 2 seconds - power off / on**

# Index

- Manufacturing
- Arduino programming
- Possible improvements
- Building your own

**Video:** <https://youtu.be/BZJjDX5xyRM>

**GitHub:** <https://github.com/ClaudeMarais/Airsoft-HUD>

# Manufacturing

- Not cheap to develop, but fun!
  - In total about \$100
- 3D Printer
  - [Creality Ender 3 S1](#)
  - Creality Ender PLA Filament 1.75mm, accuracy +/-0.02mm
- CAD and Slicing Software
  - [MatterControl](#)

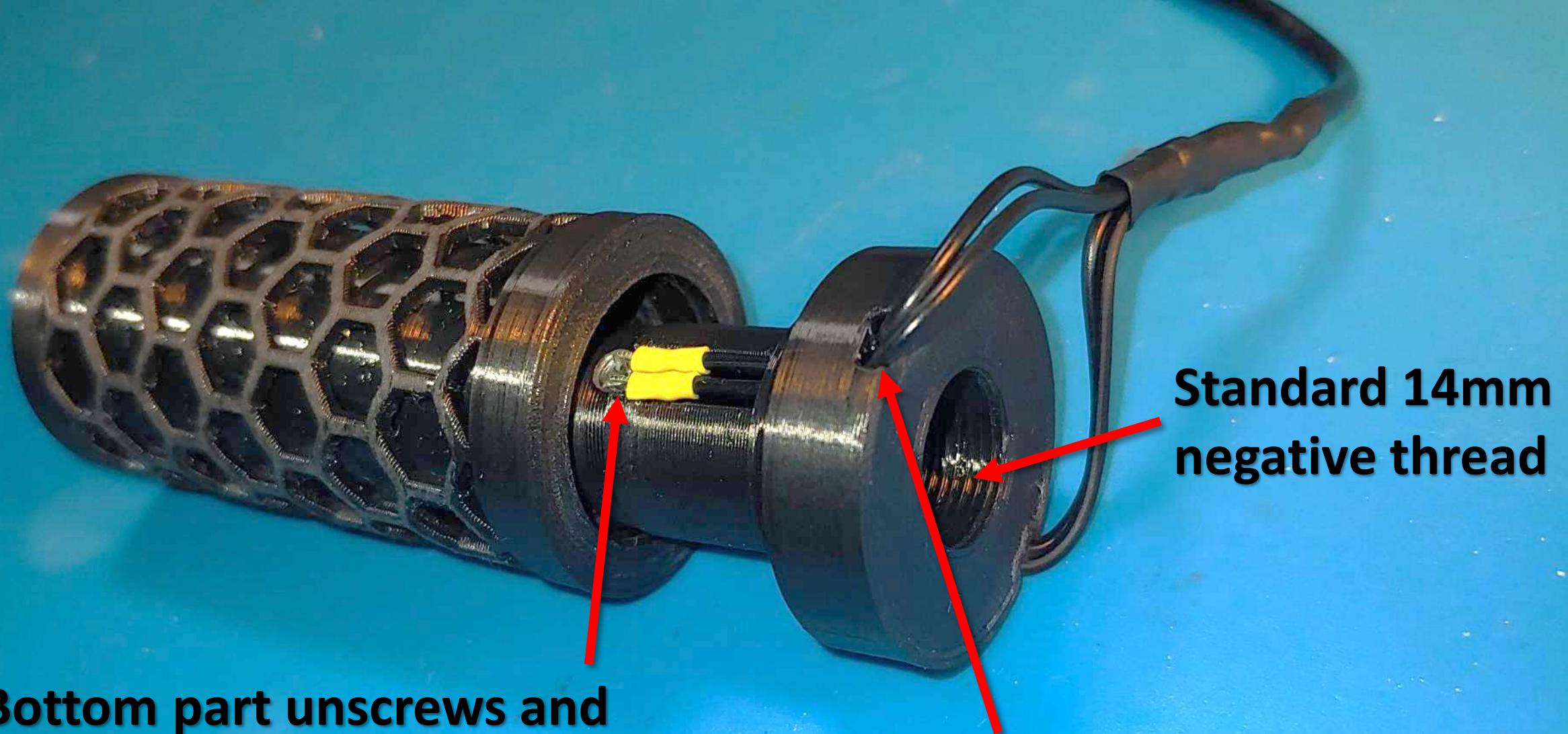
Consists of two  
main parts  
and a nice box





**Part 1 - Mock  
suppressor with four  
wires coming out the  
back**

**Lightly sanded  
honeycomb section for  
a two-tone effect**

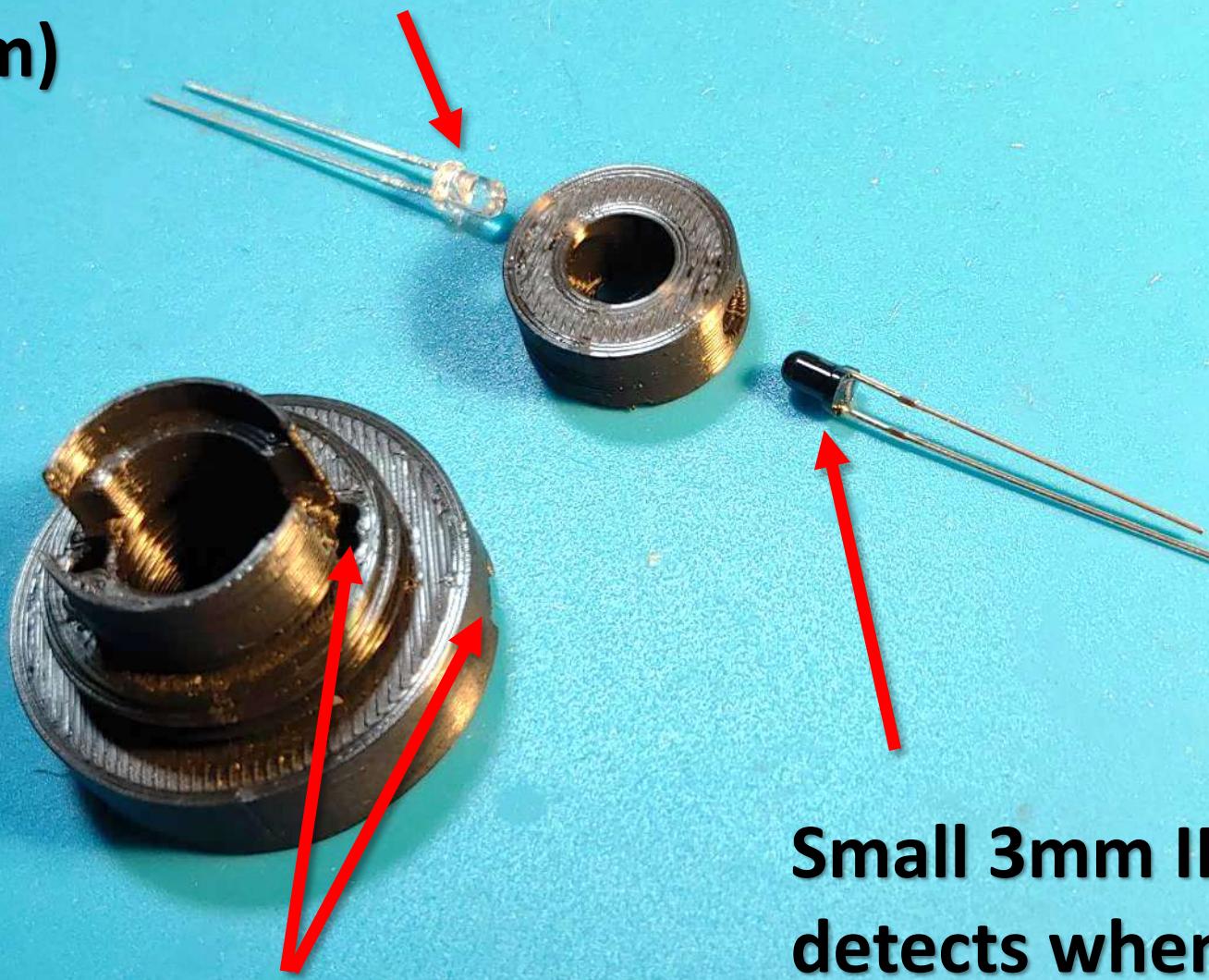


**Bottom part unscrews and holds an IR Transmitter LED and an IR Receiver sensor**

**Very small holes in the 3D print hides the wires as much as possible**

**Standard 14mm negative thread**

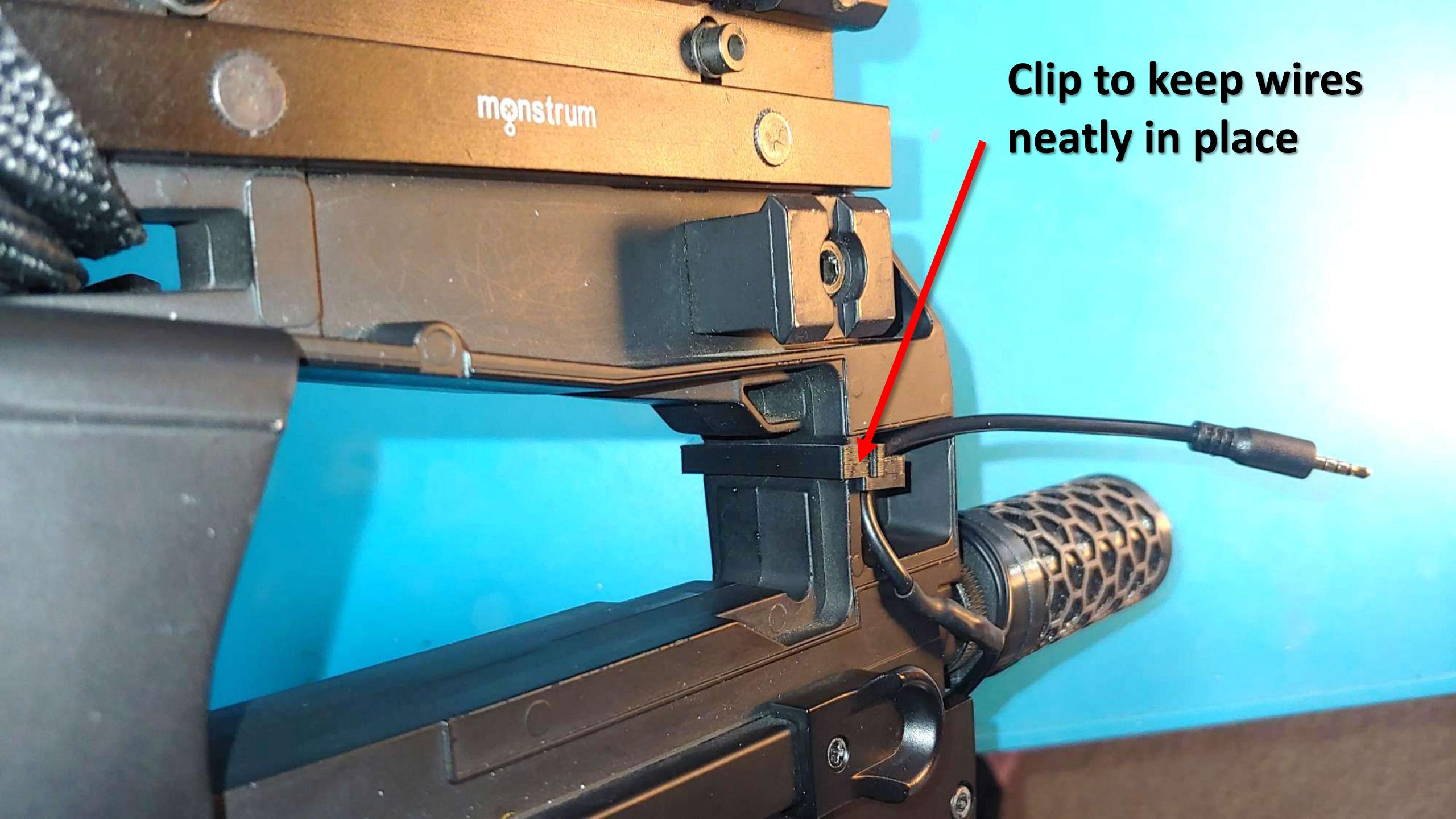
# **Small 3mm IR Transmitter LED (940nm)**



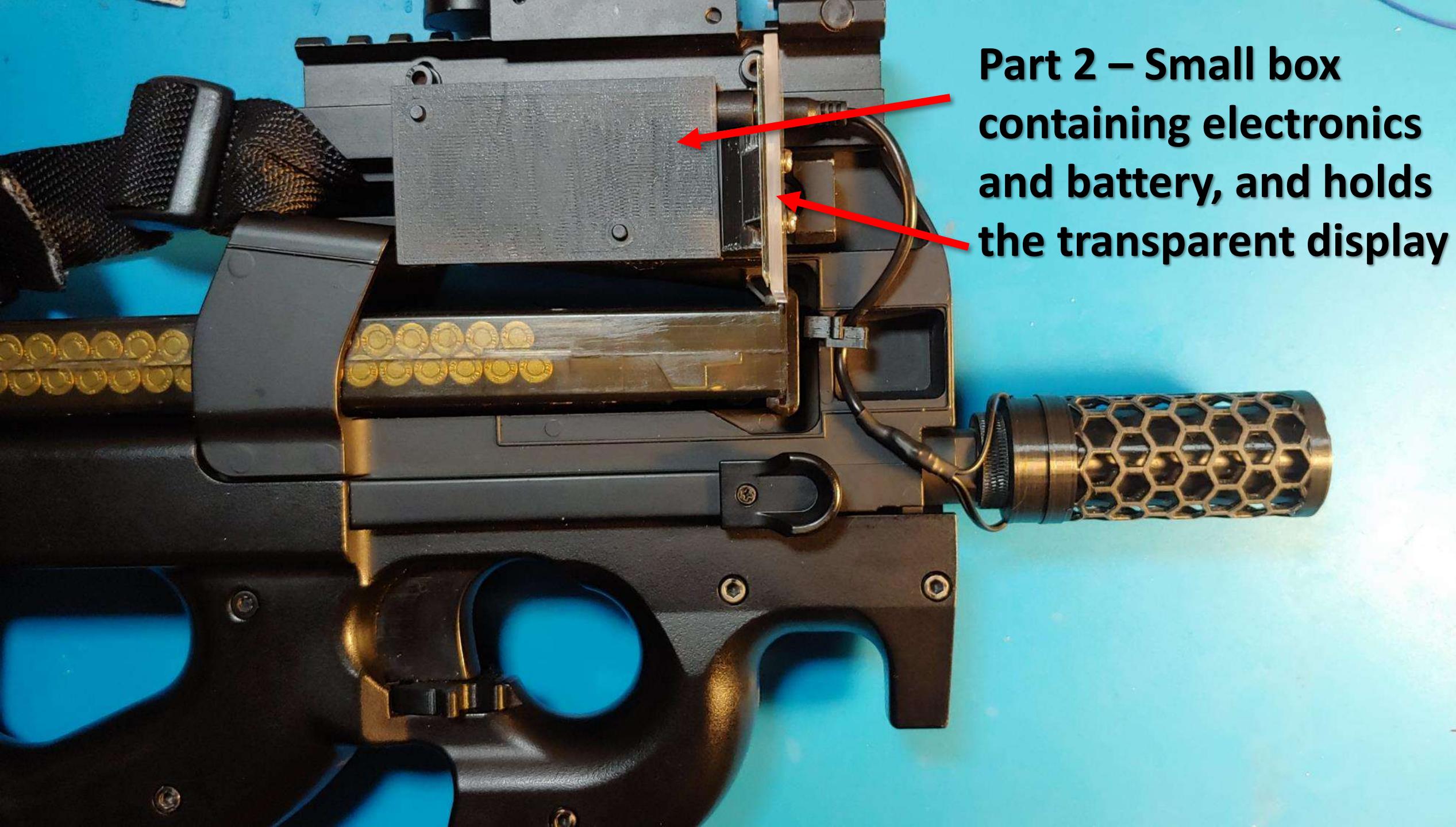
**Small wire holes**

**Small 3mm IR Receiver sensor  
detects when BB obstructs IR  
Transmitter**





**Clip to keep wires  
neatly in place**

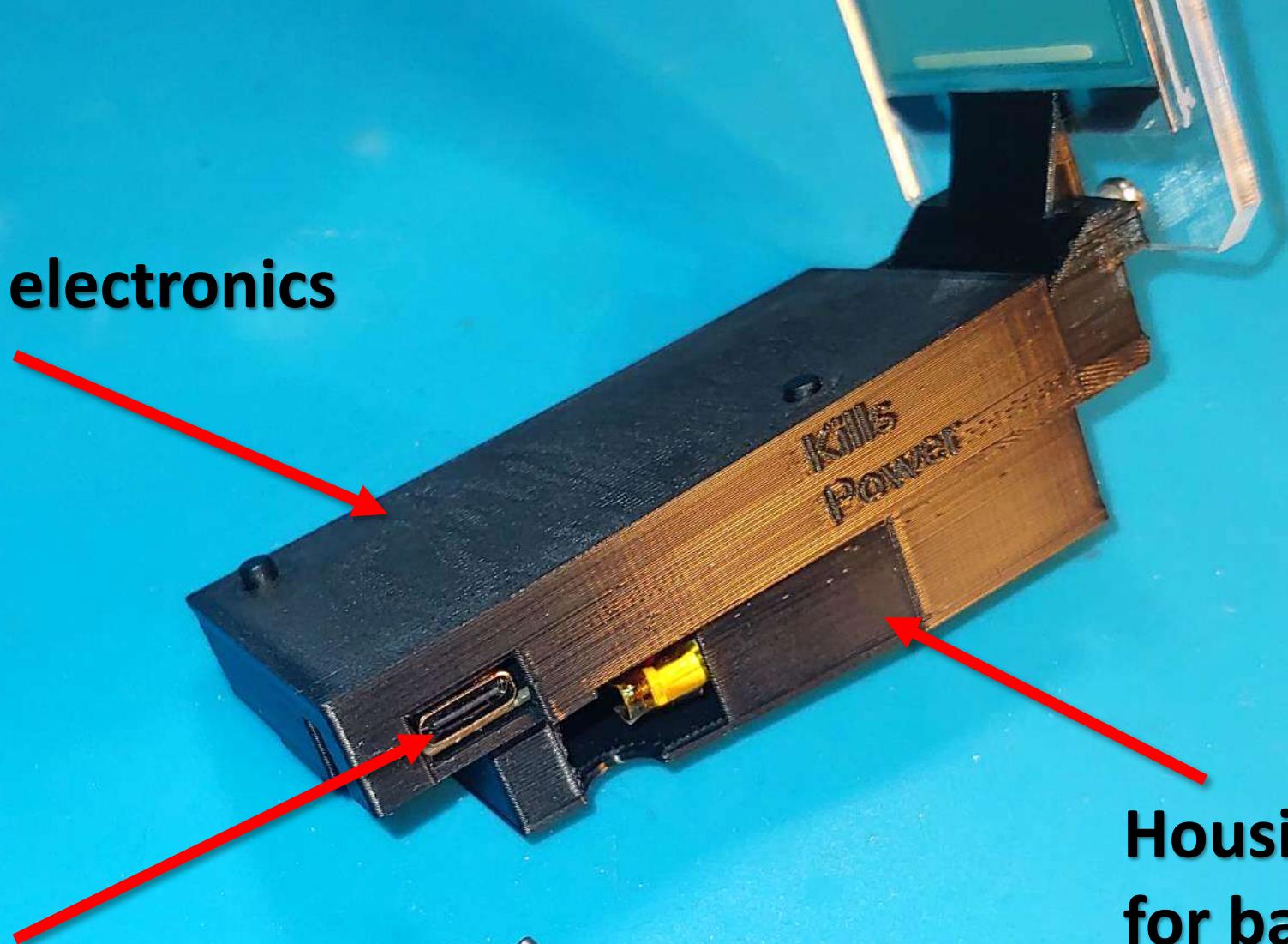


**Part 2 – Small box containing electronics and battery, and holds the transparent display**



**TRRS cable with 4 wires  
is perfect to attach  
mock suppressor wires  
to box with electronics**

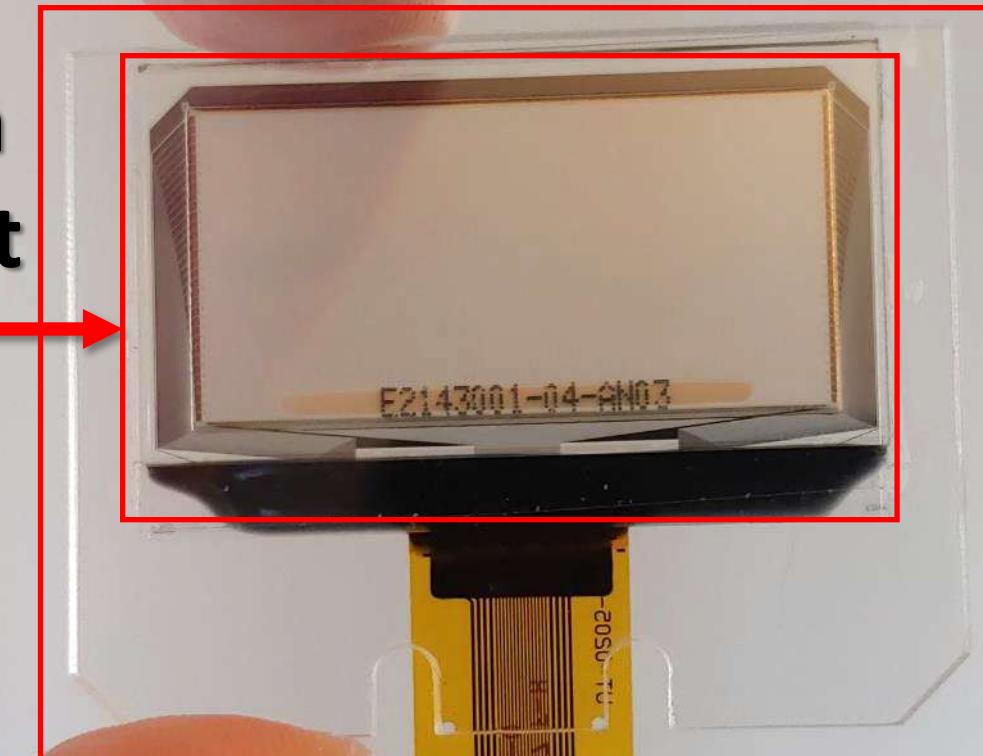
**Housing for electronics**



**USB-C to charge battery  
and upload software**

**Housing  
for battery**

**Cell phone screen  
protector on front**



**Protective  
plexiglass on  
back**



Cut plexiglass to  
right size and  
sand neatly

39 mm

Screw  
holes

49.5 mm

2.5 mm

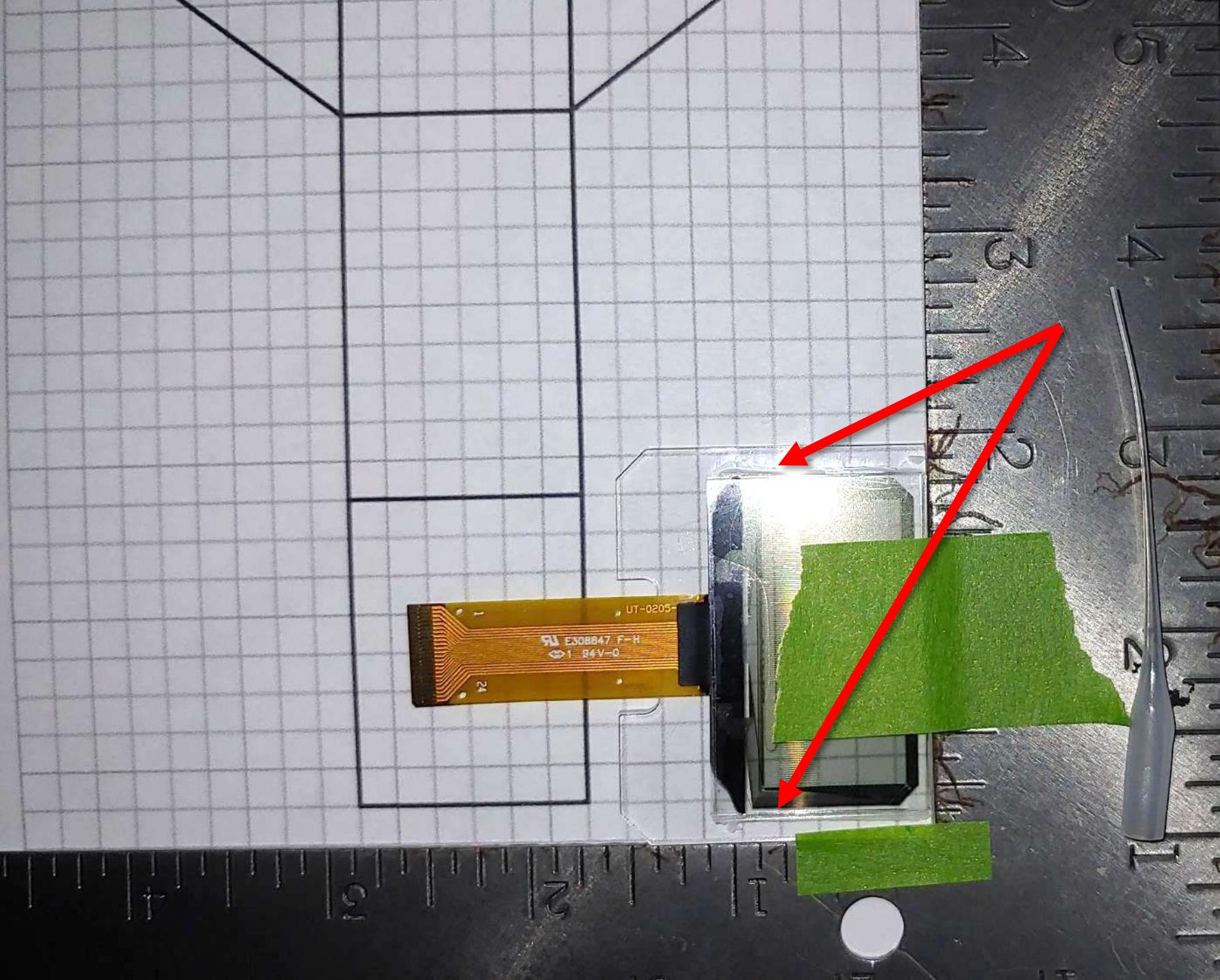
3mm  
0.12"

8mm  
0.31"

M3 x 8



Use transparent glue to attach OLED glass **behind** plexiglass. This is **permanent**, so be careful and get it straight!



**2.5mm TRRS Connector (4 wires)**

**Resistors**

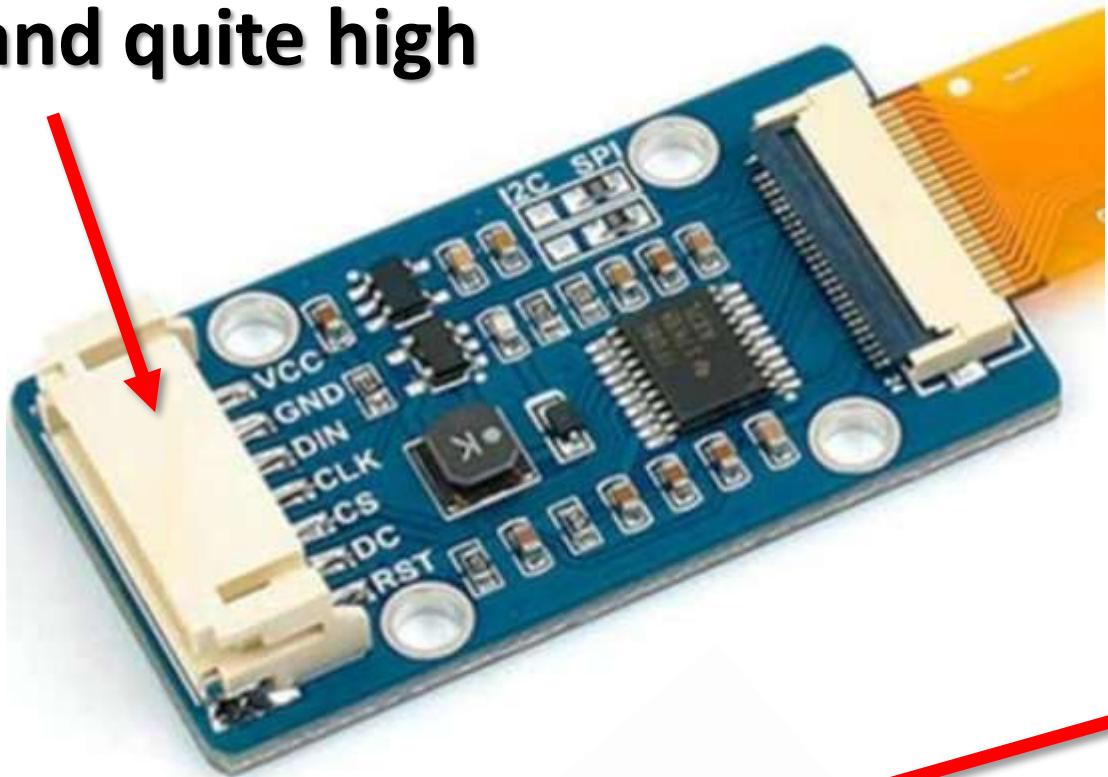
**Push  
Buttons**

**ESP32-C3**

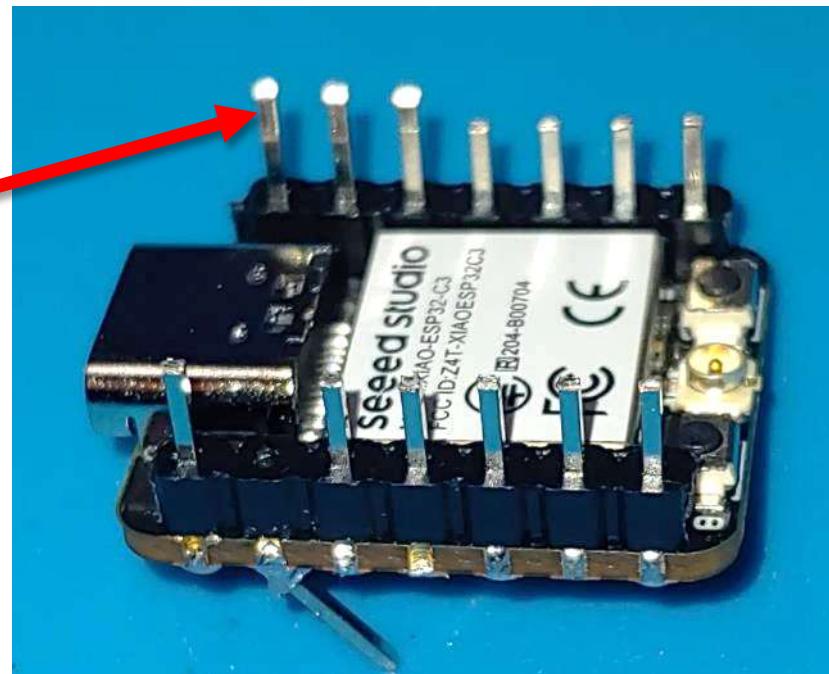
**Display driver board**

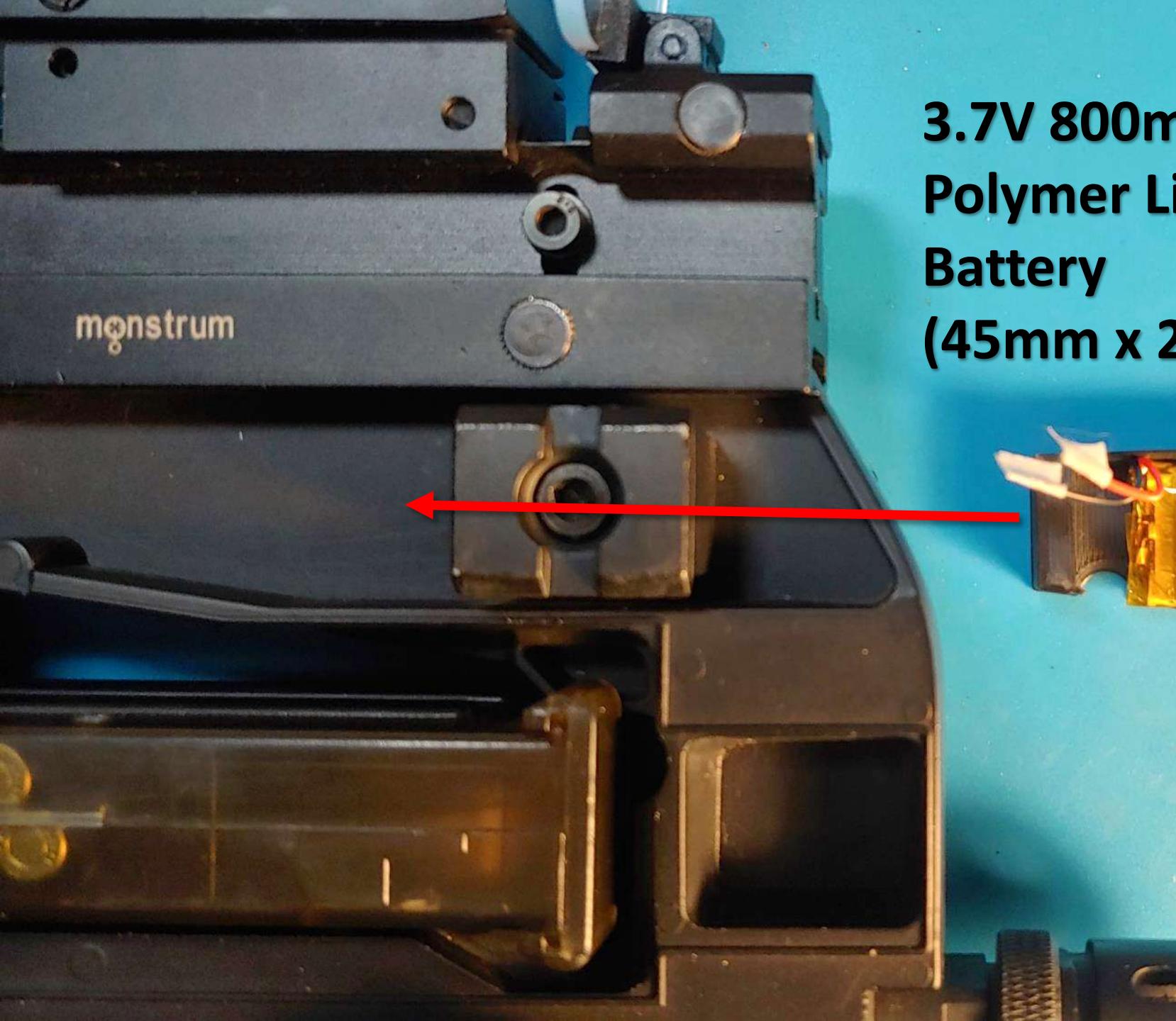
**Display and  
plexiglass**

**Connector difficult to remove  
and quite high**

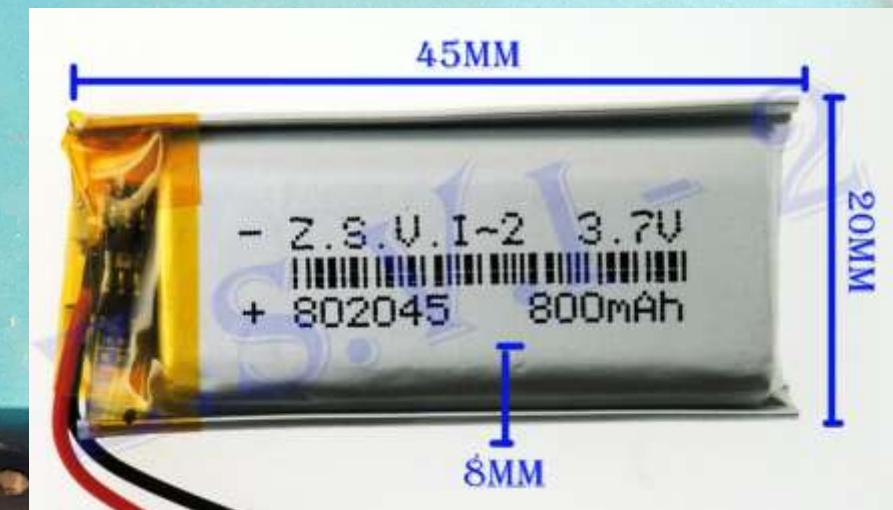


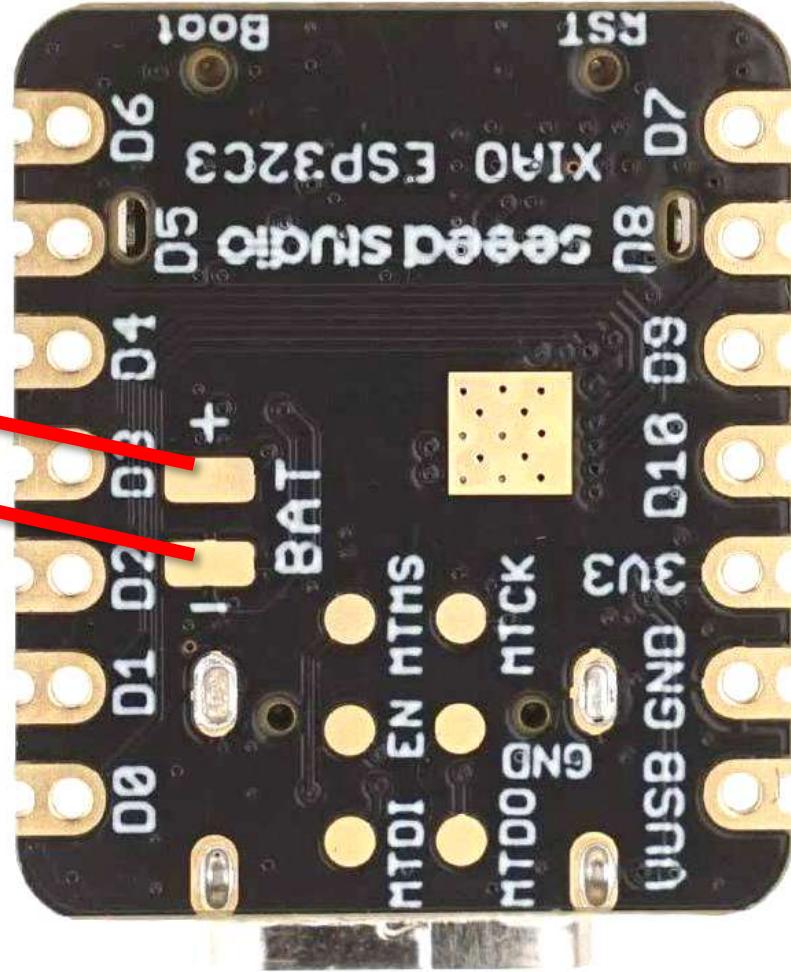
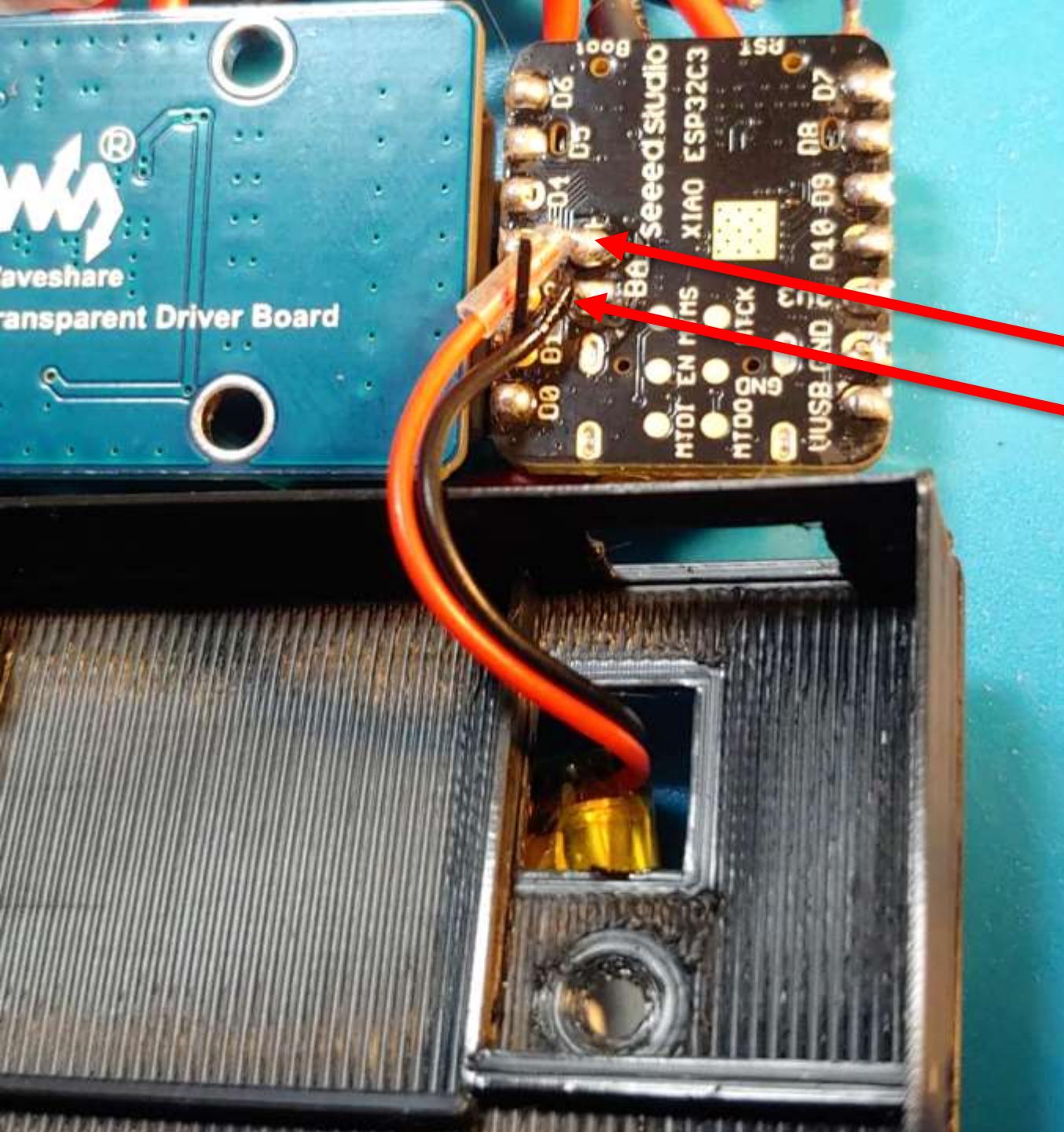
**Solder breadboard pin  
header strip upside down,  
long part pointing upward,  
for wires to easily reach over  
high connector**





**3.7V 800mAh 802045 Lithium  
Polymer LiPo Rechargeable  
Battery  
(45mm x 20mm x 8mm)**





**Do this last! Carefully  
solder LiPo battery to  
ESP32-C3**

# How the design evolved



A mountain of prototyping!



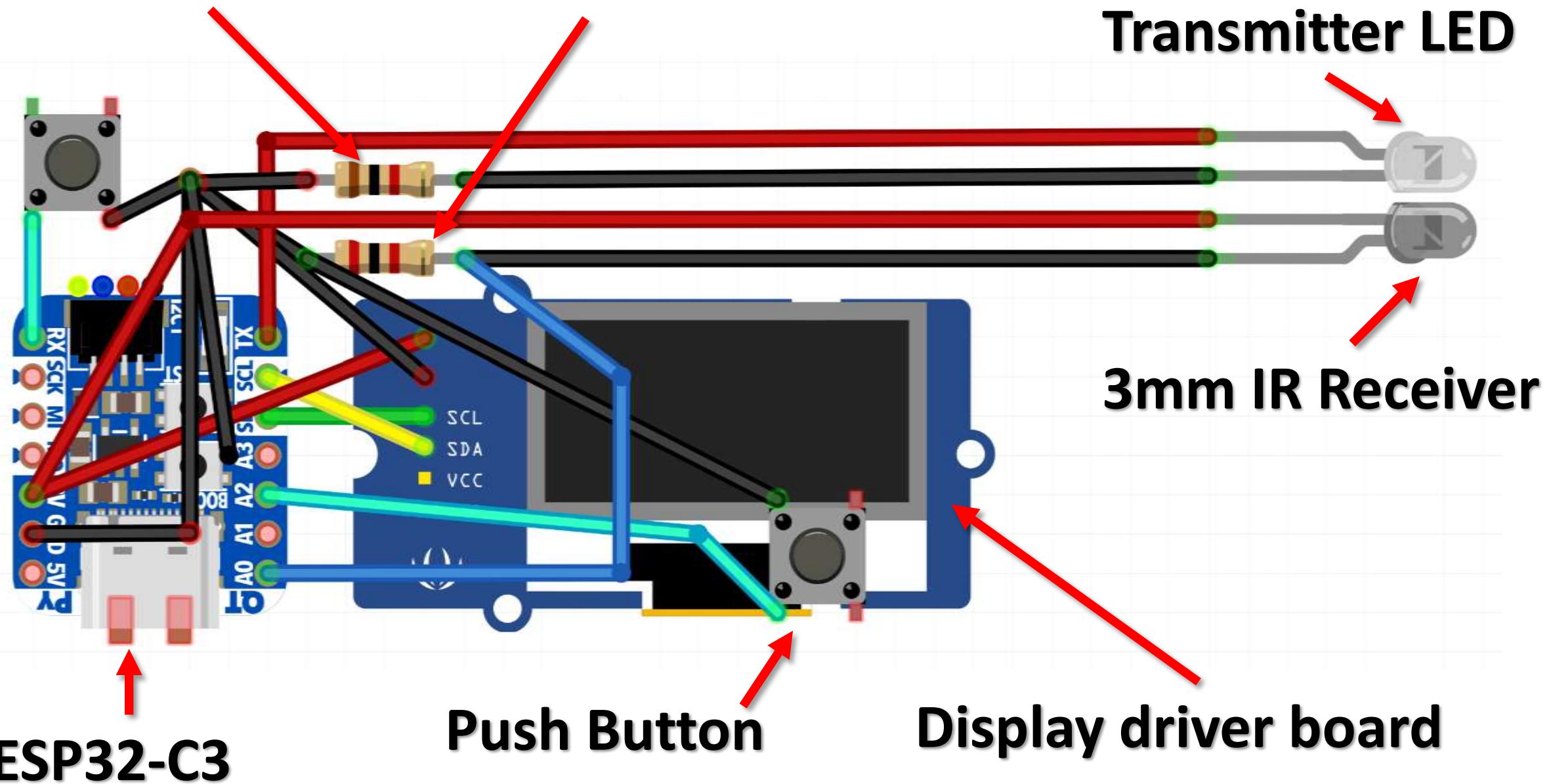
# Arduino Programming

- Wire diagram
- SSD1309 Transparent OLED Display
- Detecting a BB
- Deep sleep instead power off

**1K Resistor**

**2K Resistor**

**3mm IR  
Transmitter LED**



# SSD1309 Transparent OLED Display

- Switch from SPI to I2C
  - Move the two 0hm resistors to the left
- Use [U8g2](#) display library



```
#include <Wire.h>          // I2C interface
#include <U8g2lib.h>        // Display library

U8G2_SSD1309_128X64_NONAME2_F_HW_I2C display(U8G2_R3);
```

# Detecting a BB

```
// Keep track of when BBs are detected
volatile bool bbDetected = false;
volatile unsigned long bbDetectedTime = millis();

// ISR when BB is detected
void bbDetectedISR()
{
    bbDetected = true;
    bbDetectedTime = millis();
}

void setup()
{
    // Setup IR transmitter LED
    pinMode(pinIRTransmitter, OUTPUT);
    digitalWrite(pinIRTransmitter, HIGH);

    // Setup interrupt to detect BBs. When a BB passes between the IR transmitter and receiver,
    // the voltage will change from HIGH to LOW, i.e. use FALLING
    attachInterrupt(pinIRReceiver, bbDetectedISR, FALLING);
```

**No obstruction, pin has HIGH voltage**



**BB obstructs sensor, pin has LOW voltage**



# Deep sleep instead of power off

- No physical on/off power switch
- Just put device into deep sleep
- Wakeup device with interrupt from button press
- Spec for XIAO ESP32-C3 says it only uses 44uA in deep sleep
- 800mAh battery should last for several months without charging

```
// Setup deep sleep to wake up on a front button press
esp_deep_sleep_enable_gpio_wakeup(1ULL << D2, ESP_GPIO_WAKEUP_GPIO_LOW);

// Now we're ready to deep sleep
esp_deep_sleep_start();
```

# Possible Improvements

- **Detect magazine swaps to auto reset BB count**
  - Add small micro switch on cable clip where the magazine touches
- **Connect with phone app**
  - ESP32-C3 has Bluetooth capabilities
  - Can connect to phone app to save info, e.g. kills, deaths, num BBs shot, num magazines used, duration of game, etc.
- **Add GPS for location data**
  - Connect small Arduino GPS to ESP32-C3
  - Can store where and when kills/deaths happened, and show on a map

# Building your own

- What to buy
- 3D Printing
- Putting it together
- Programming

# What to Buy

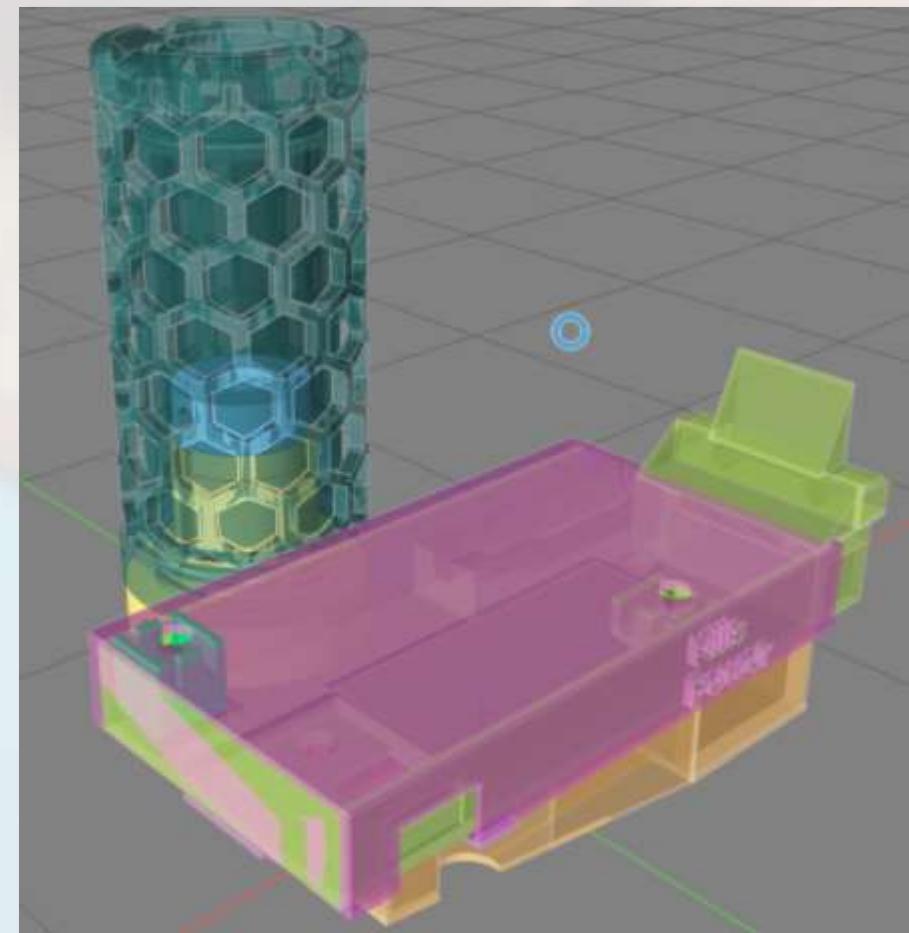
- [XIAO ESP32-C3](#)
- [SSD1309 Transparent OLED Display](#)
- [3.7V 800mAh 802045 Lithium Polymer LiPo Rechargeable Battery](#)
- [3mm IR Transmitter LED and IR Receiver](#)
- [2.5mm thick plexiglass](#)
- [Transparent Glass/Acrylic glue](#)
- [Clear film cellphone screen protector](#)
- [Momentary push buttons](#)
- [Resistors](#)
- [TRRS connector cables \(4 wire\)](#)
- [M3x8 screws](#)

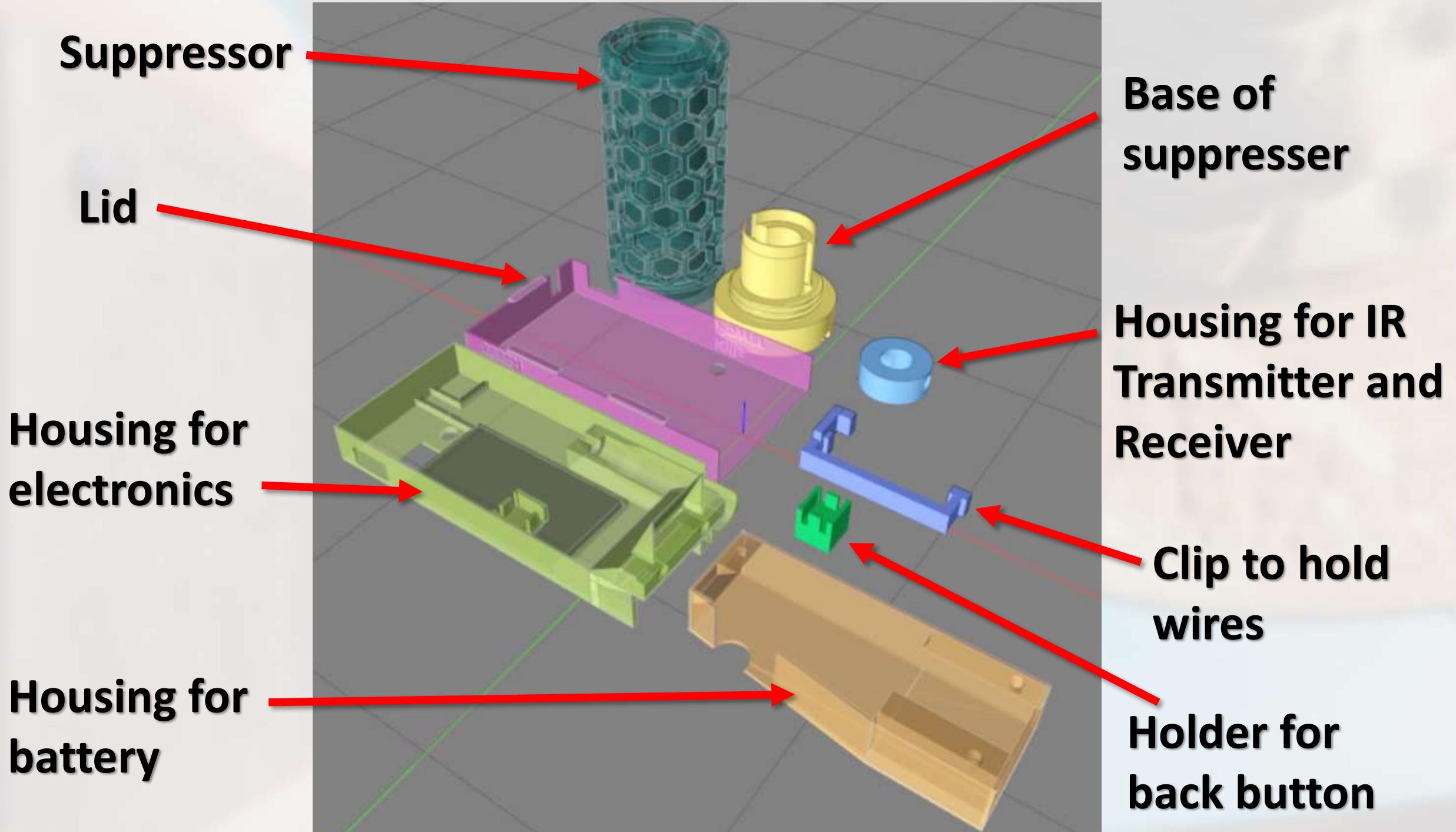
# 3D Printing

- Fits Cybergun P90
- 10 .STL files to print
- “AirsoftHUD\_AllParts.mcx”
  - Source CAD file if adjustments are needed
  - Source file is in MatterControl format
- Use PLA Filament 1.75mm, accuracy +/-0.02mm

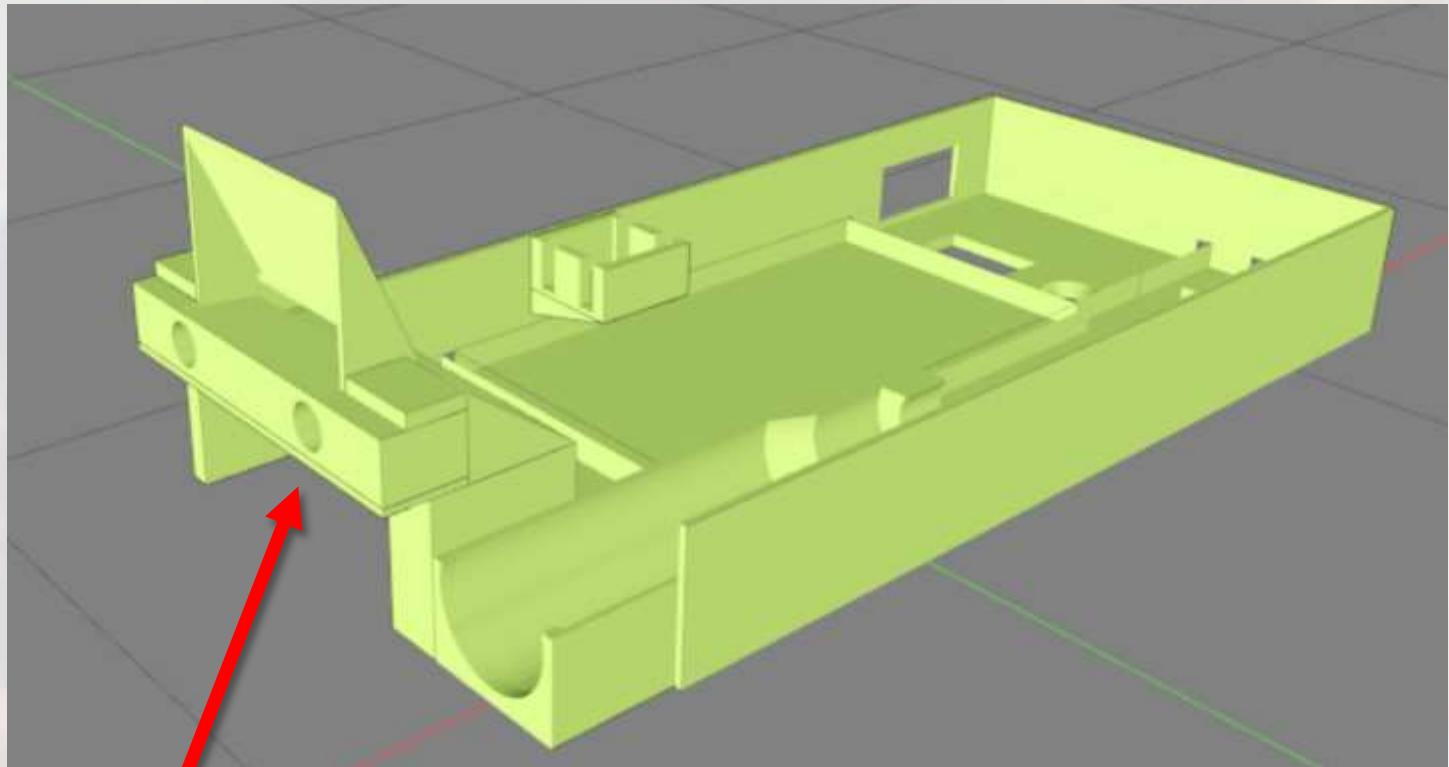
# Putting it together

- Lots of photos in this document
- “AirsoftHUD\_AllParts.mcx” also shows how all parts fit together



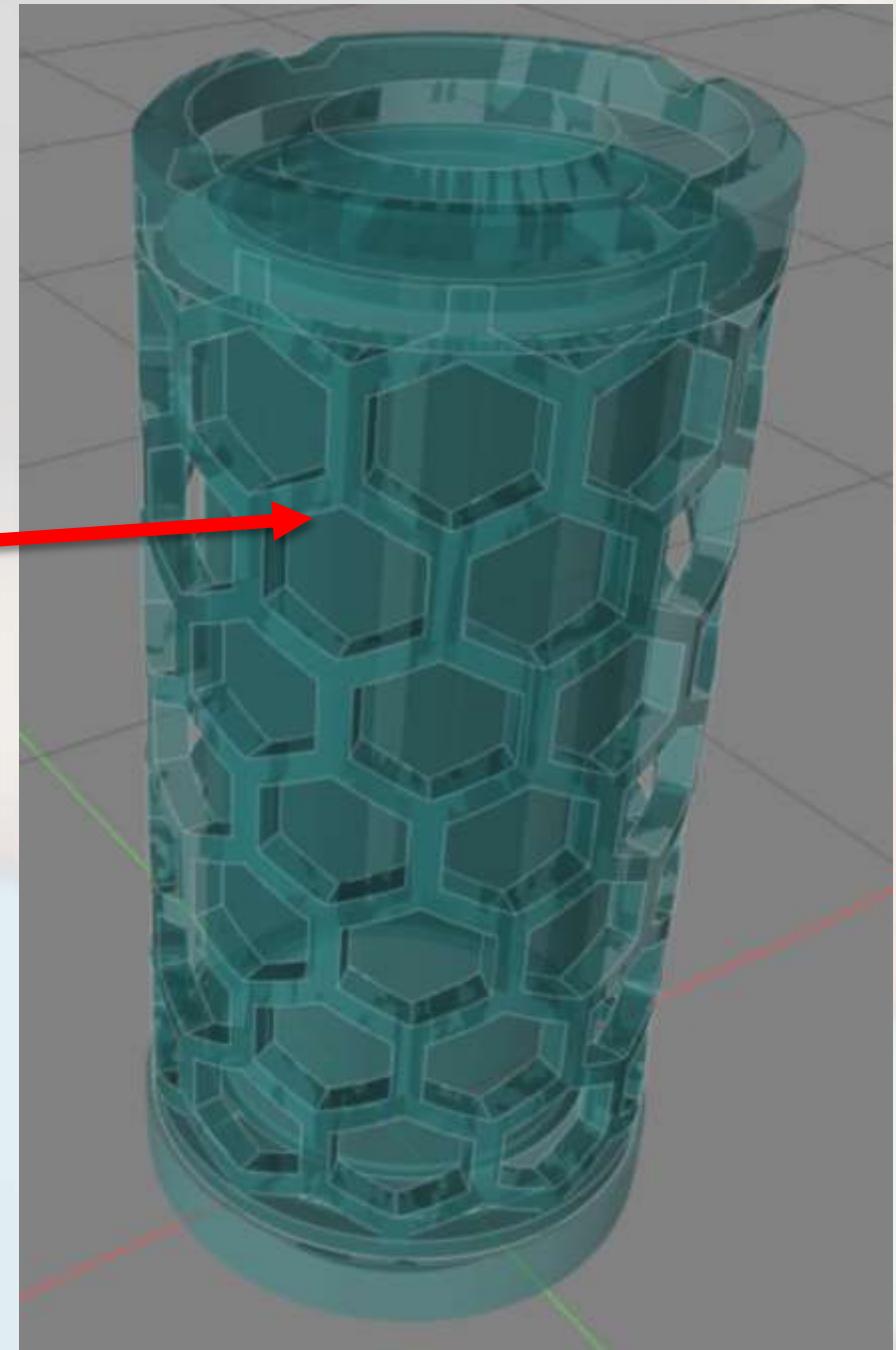


**Only this part needs to  
be printed with  
supports**

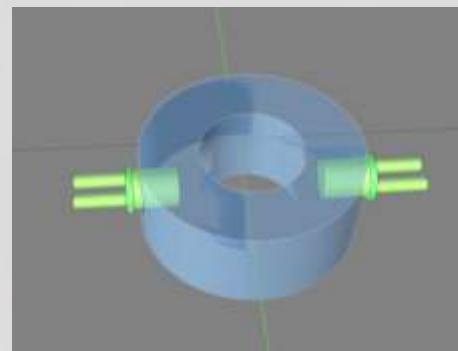


**Supports only needed for this overhang**

**Print suppressor on slow speed,  
otherwise honeycomb structure  
might collapse during print**

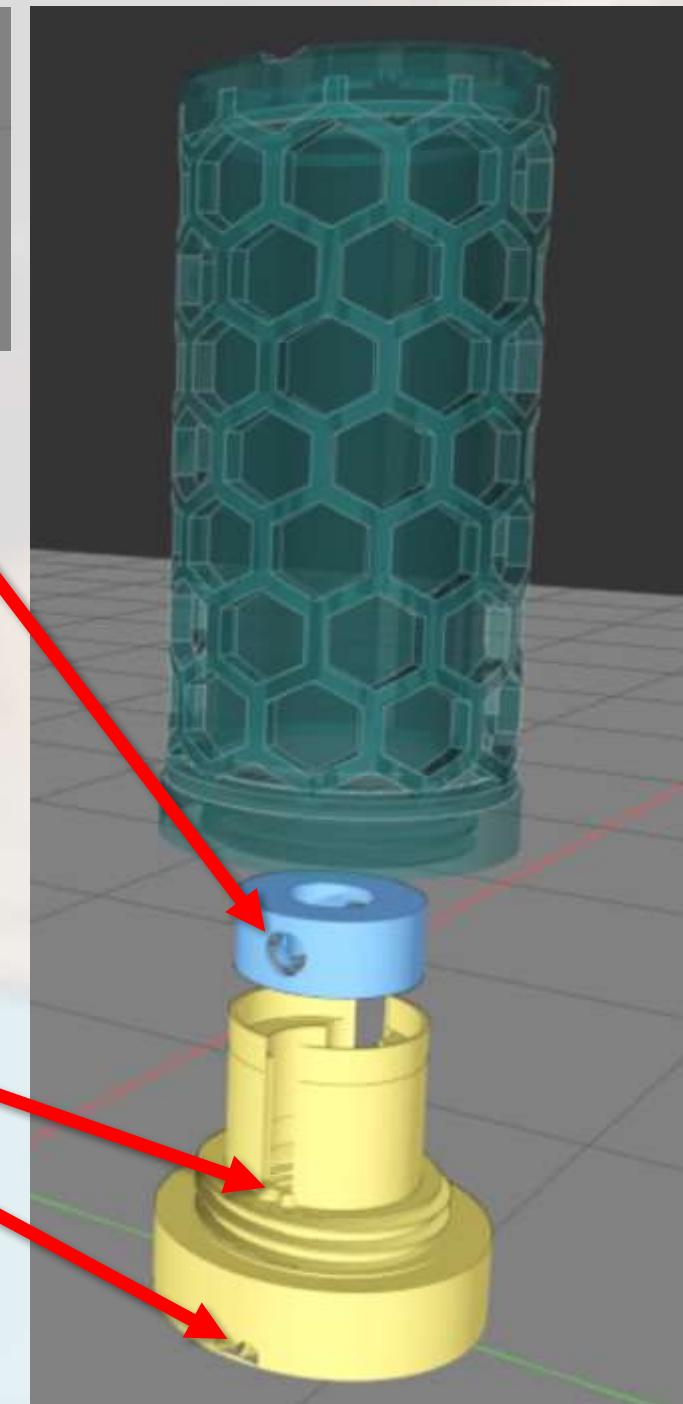


**Slide IR Transmitter and Receivers into these holes. Then solder thin wires to IR transmitter and receiver. Remember to isolate wires with shrinking tube.**

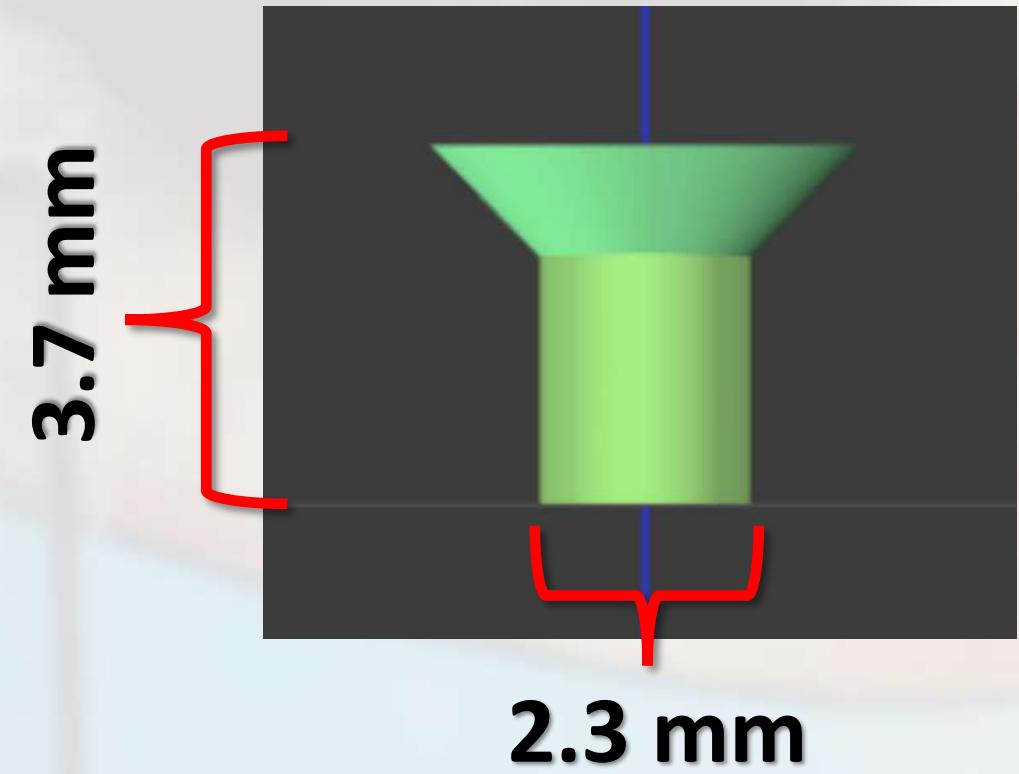
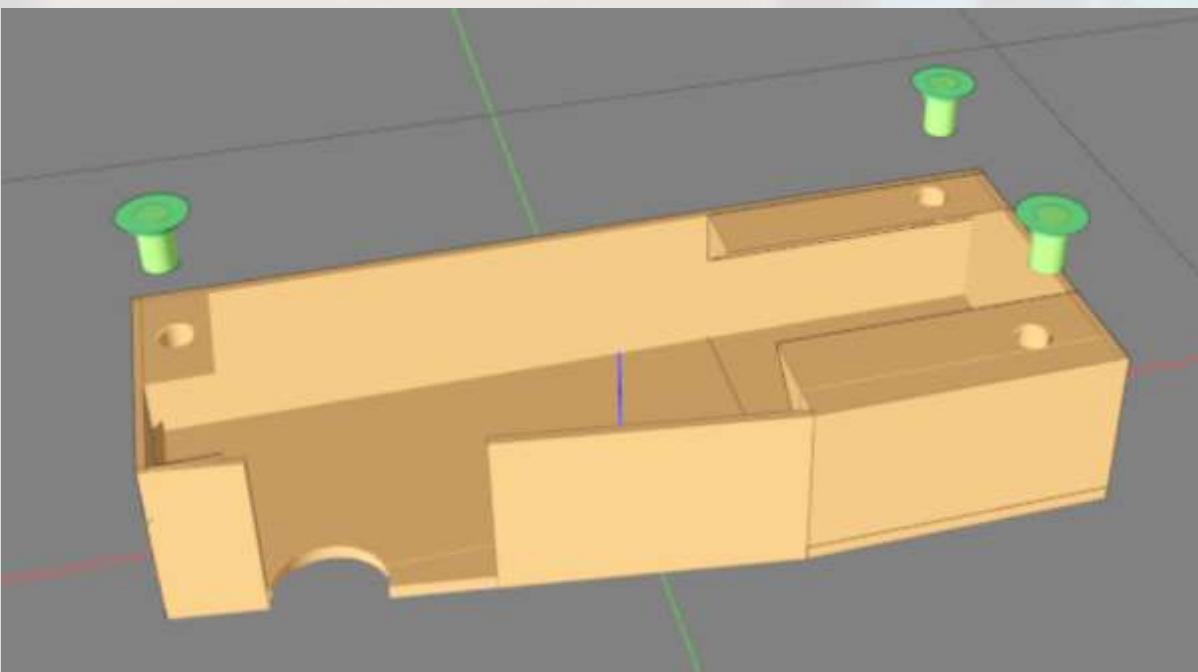


**Slide wires through these holes**

**Push blue part into yellow part and screw yellow part into bottom of suppressor**

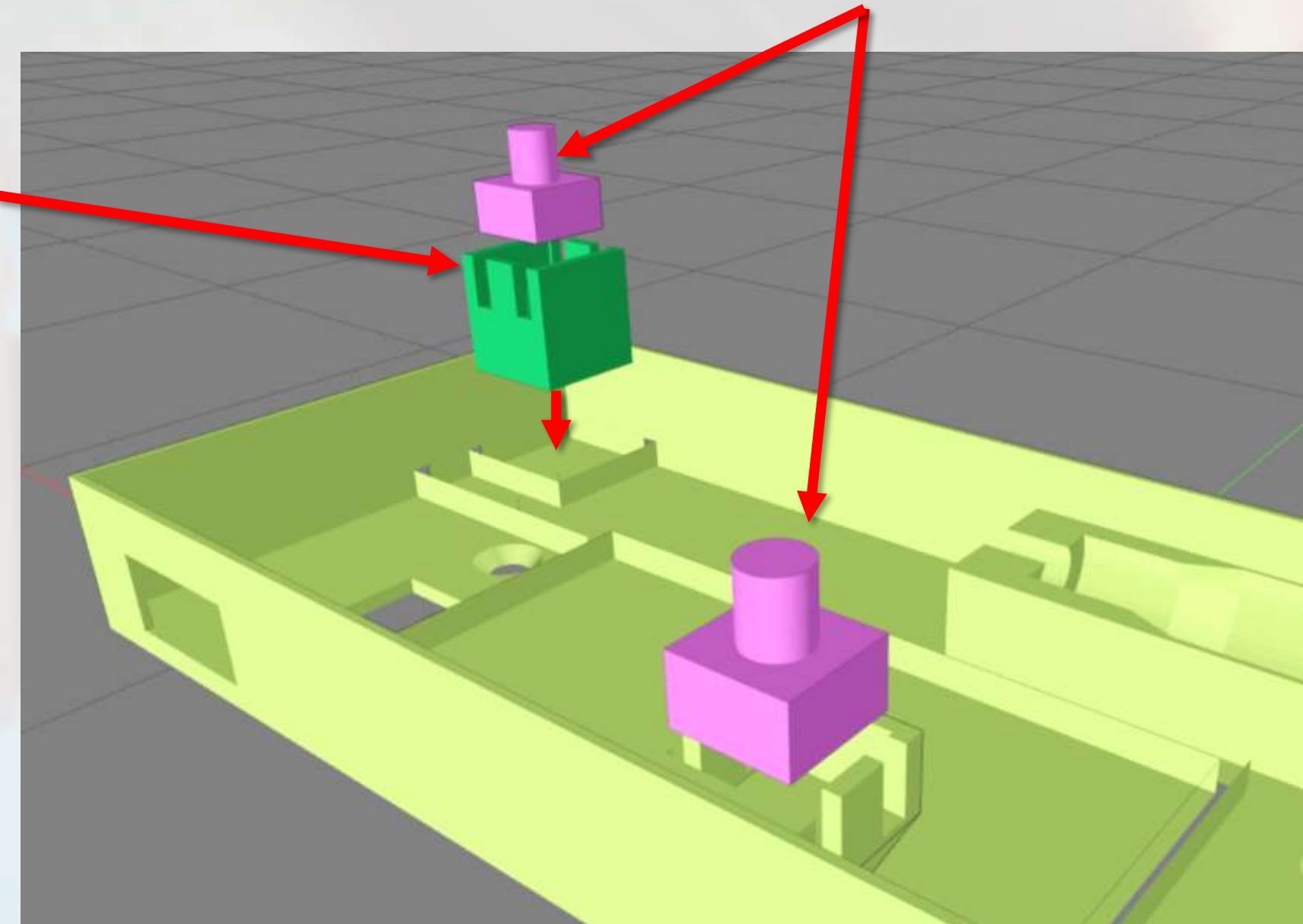


**Housing with electronics screws onto the battery housing. Holes fit small mounting screws included with transparent display.**

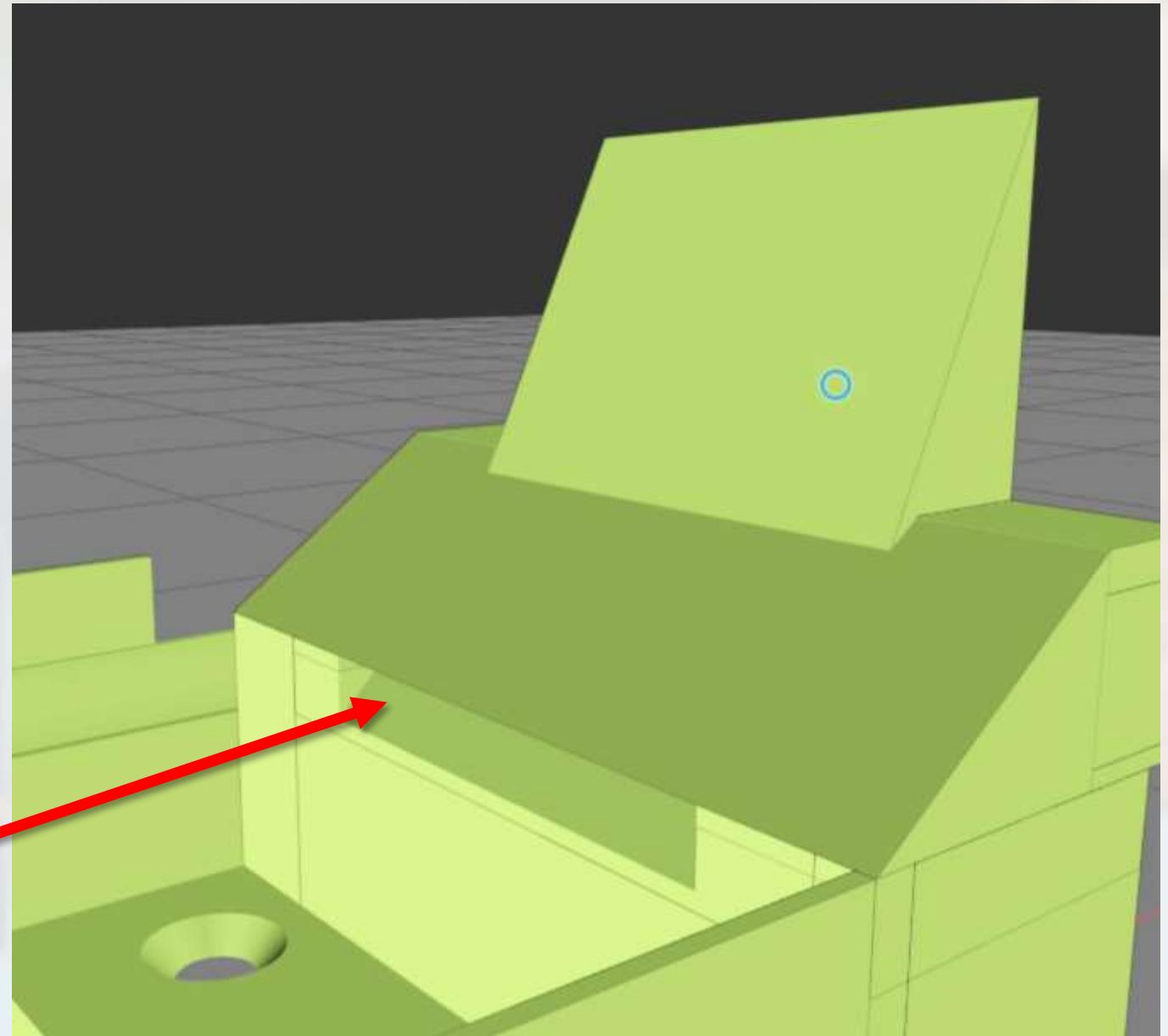


## Momentary push buttons

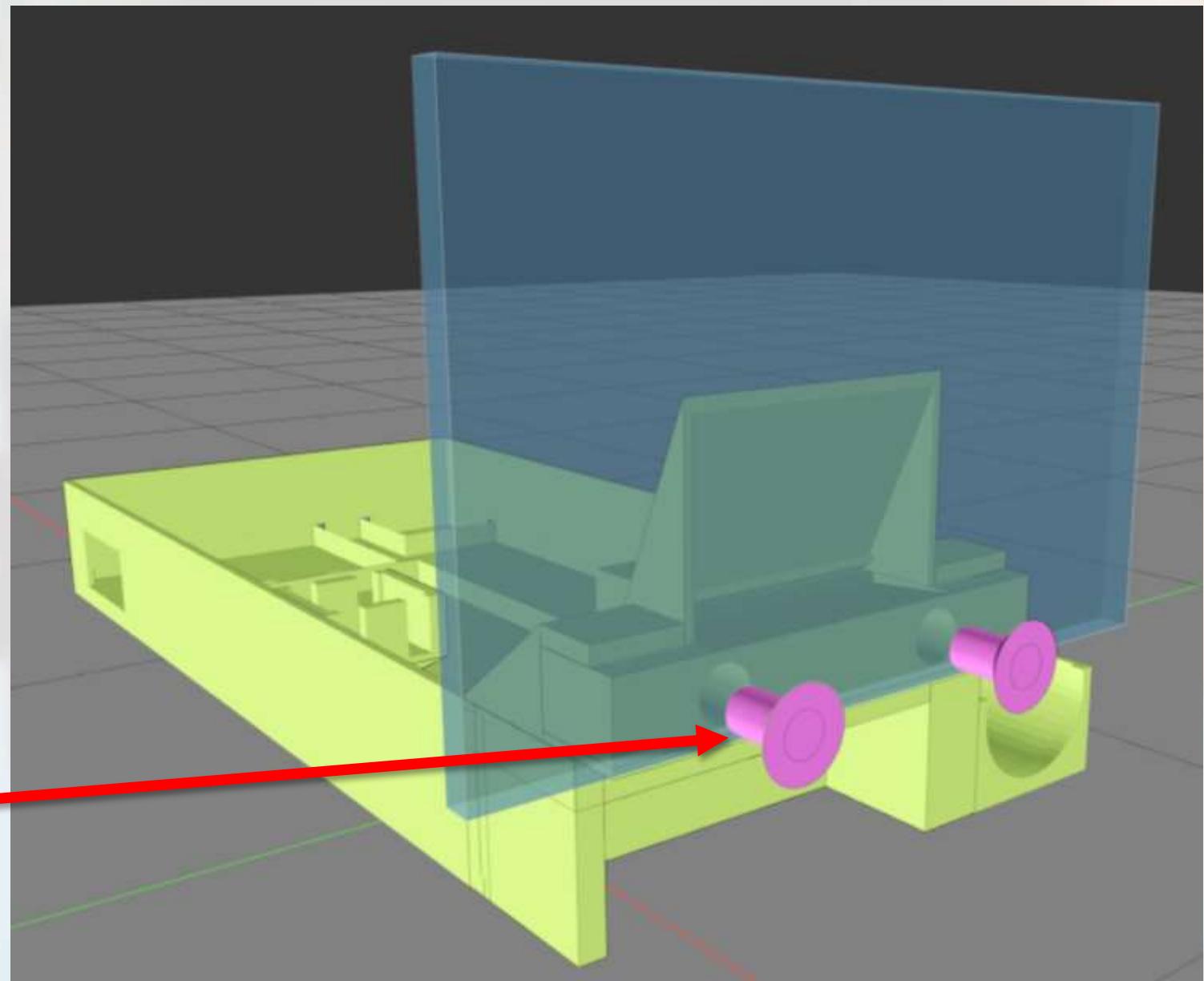
Back button housing  
is a separate print. It  
just sits in the  
cutout in the corner



**Connector ribbon of  
display slides through  
this hole**



# Attach plexiglass with display using M3x8 screws



# Programming

- Compile and upload “AirsoftHUD.ino” to ESP32-C3