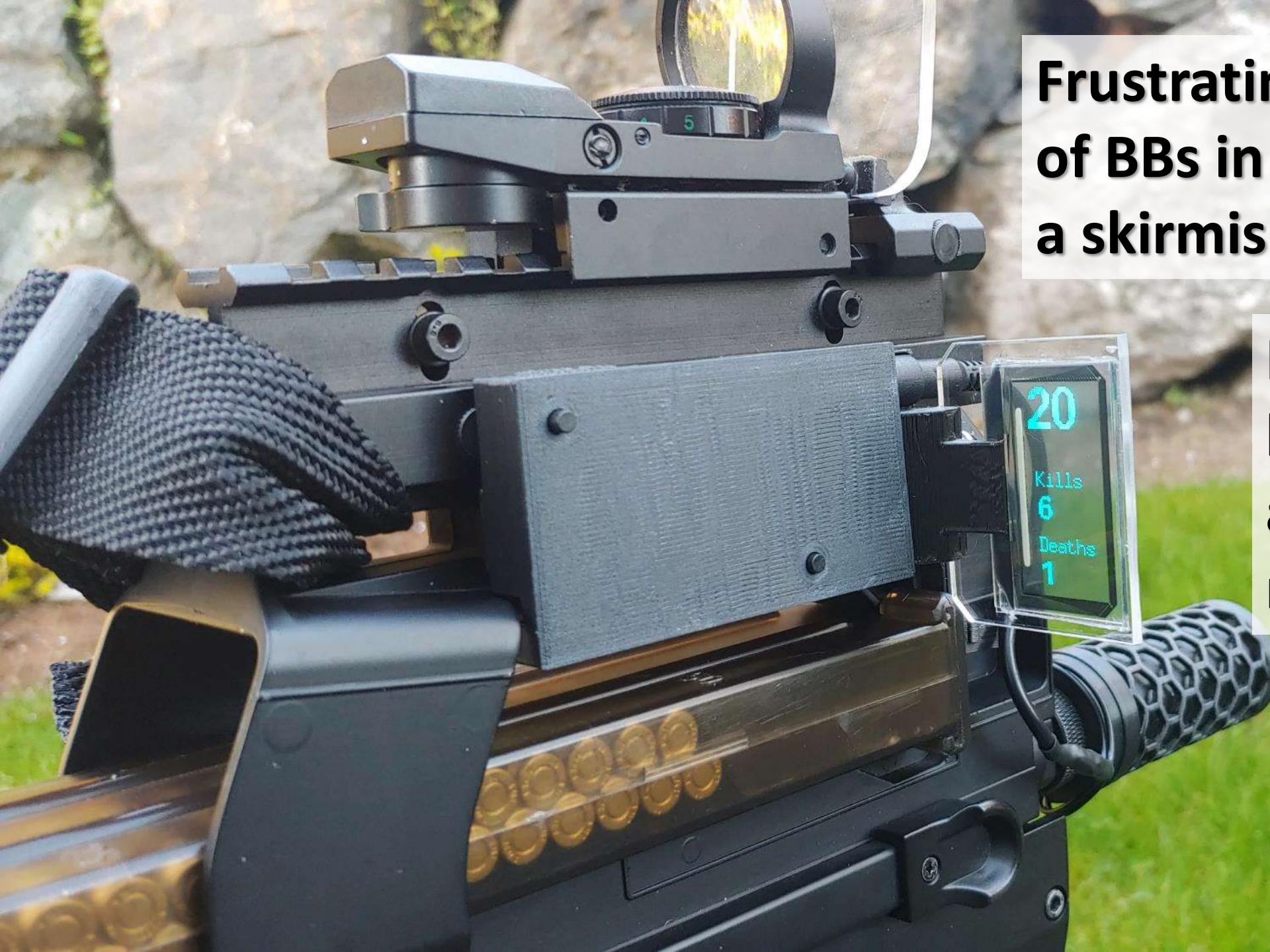


Airsoft HUD

For P90





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

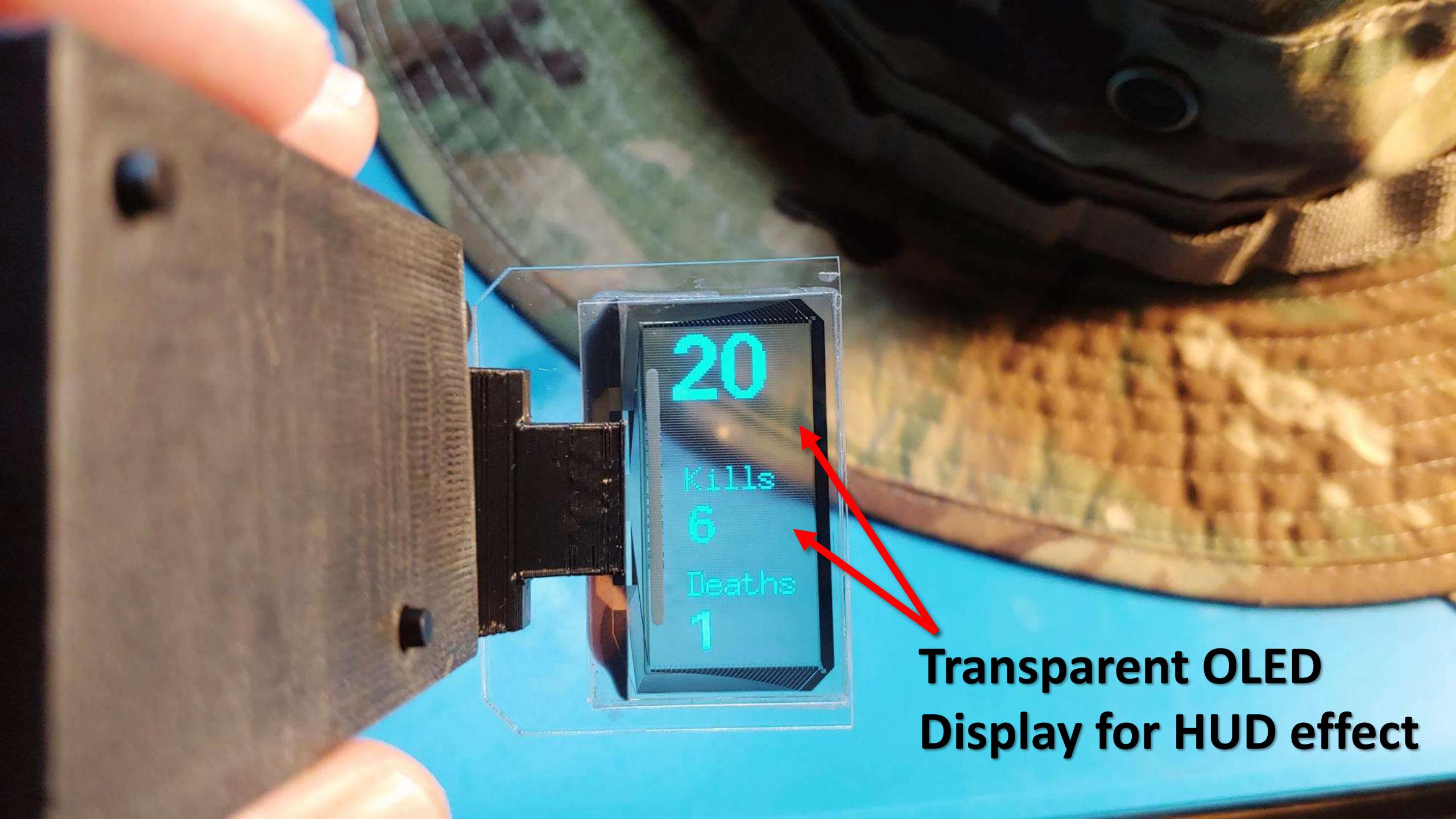
**HUD shows
how many BBs
are left in the
magazine!**



BBs left in magazine

Times you shot someone

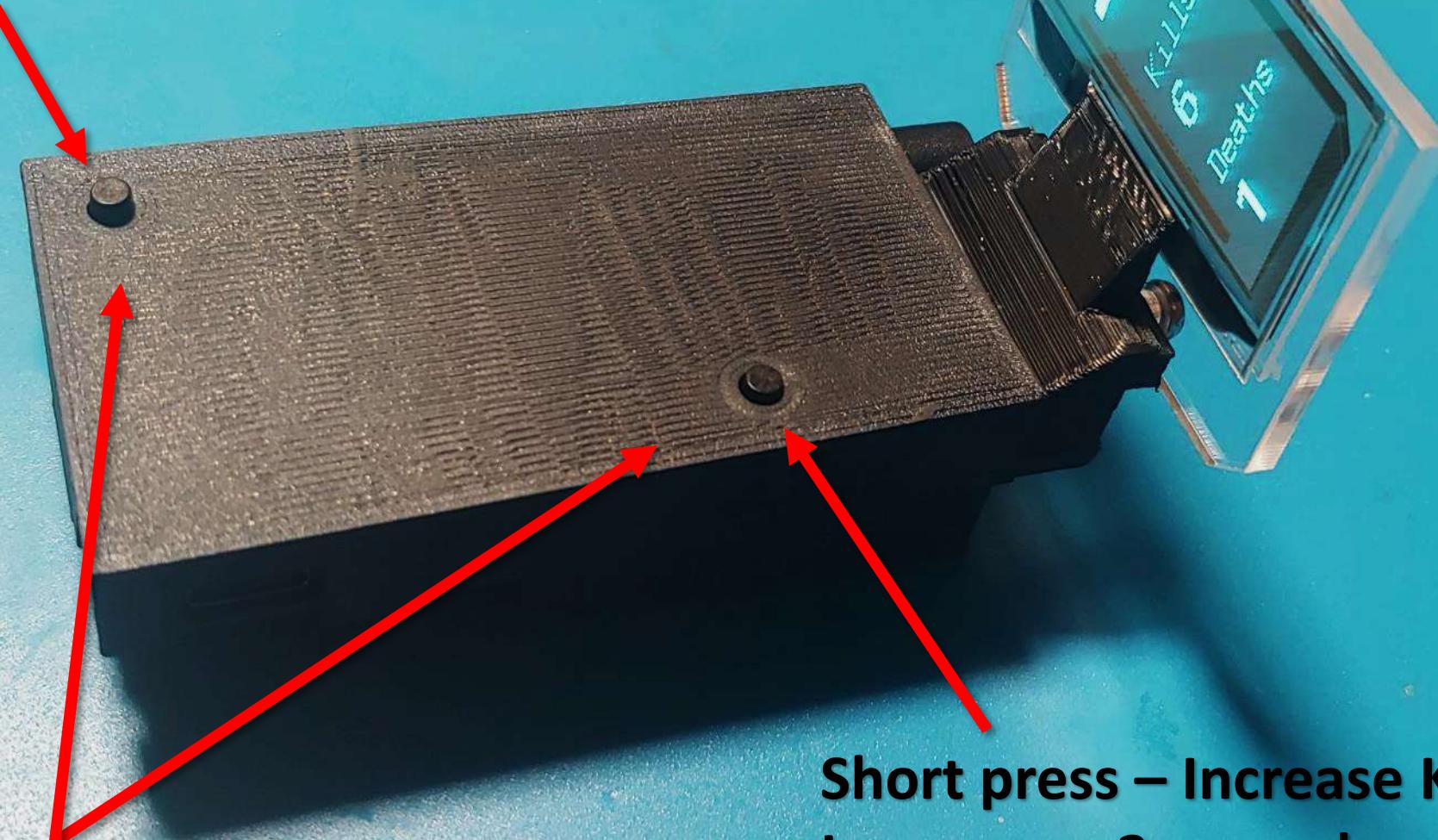
Times someone shot you



**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:

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](#)

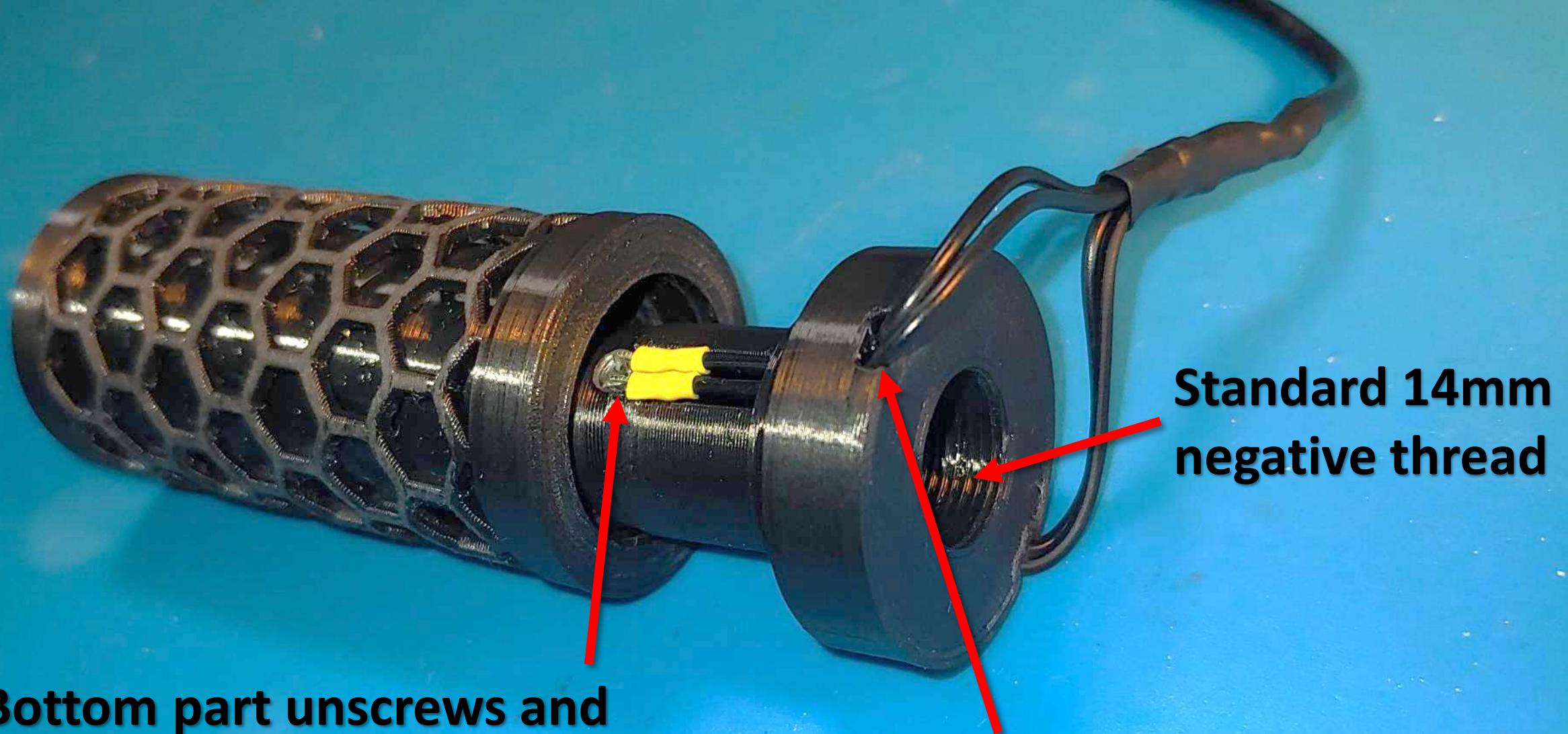
Consists of two
main parts
and a nice box





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

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

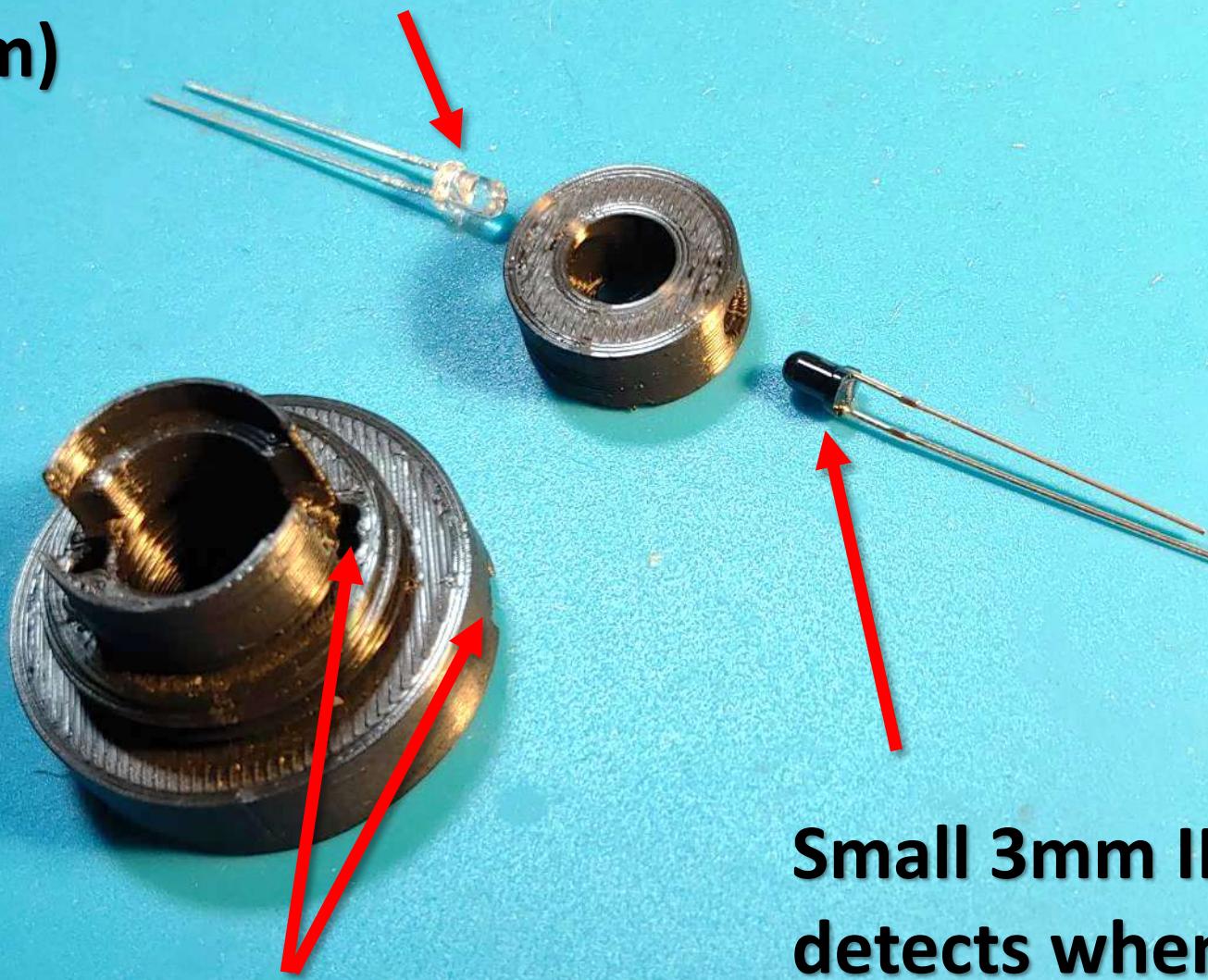


Bottom part unscrews and holds an IR Transmitter LED and an IR Receiver sensor

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

Standard 14mm negative thread

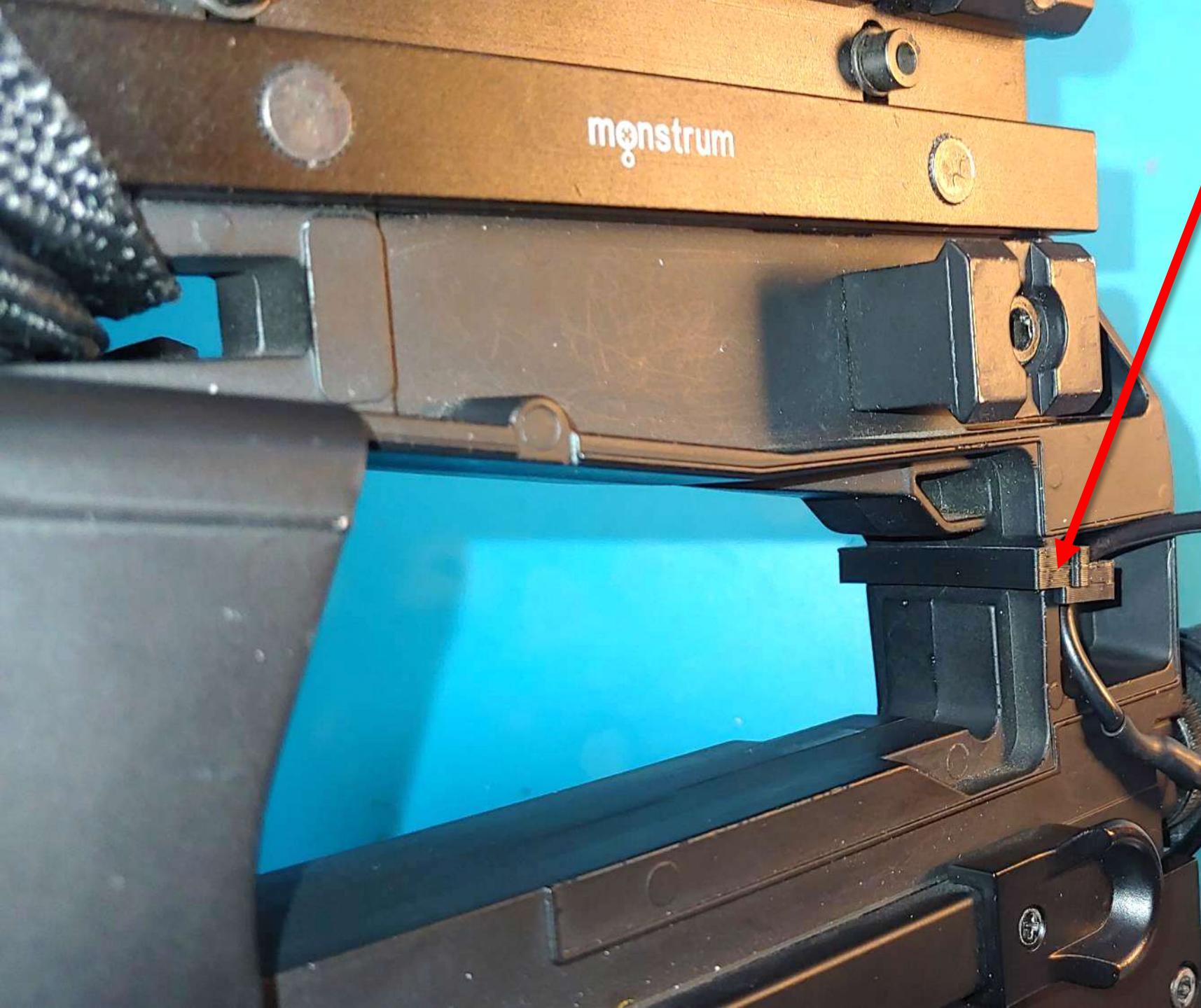
Small 3mm IR Transmitter LED (940nm)



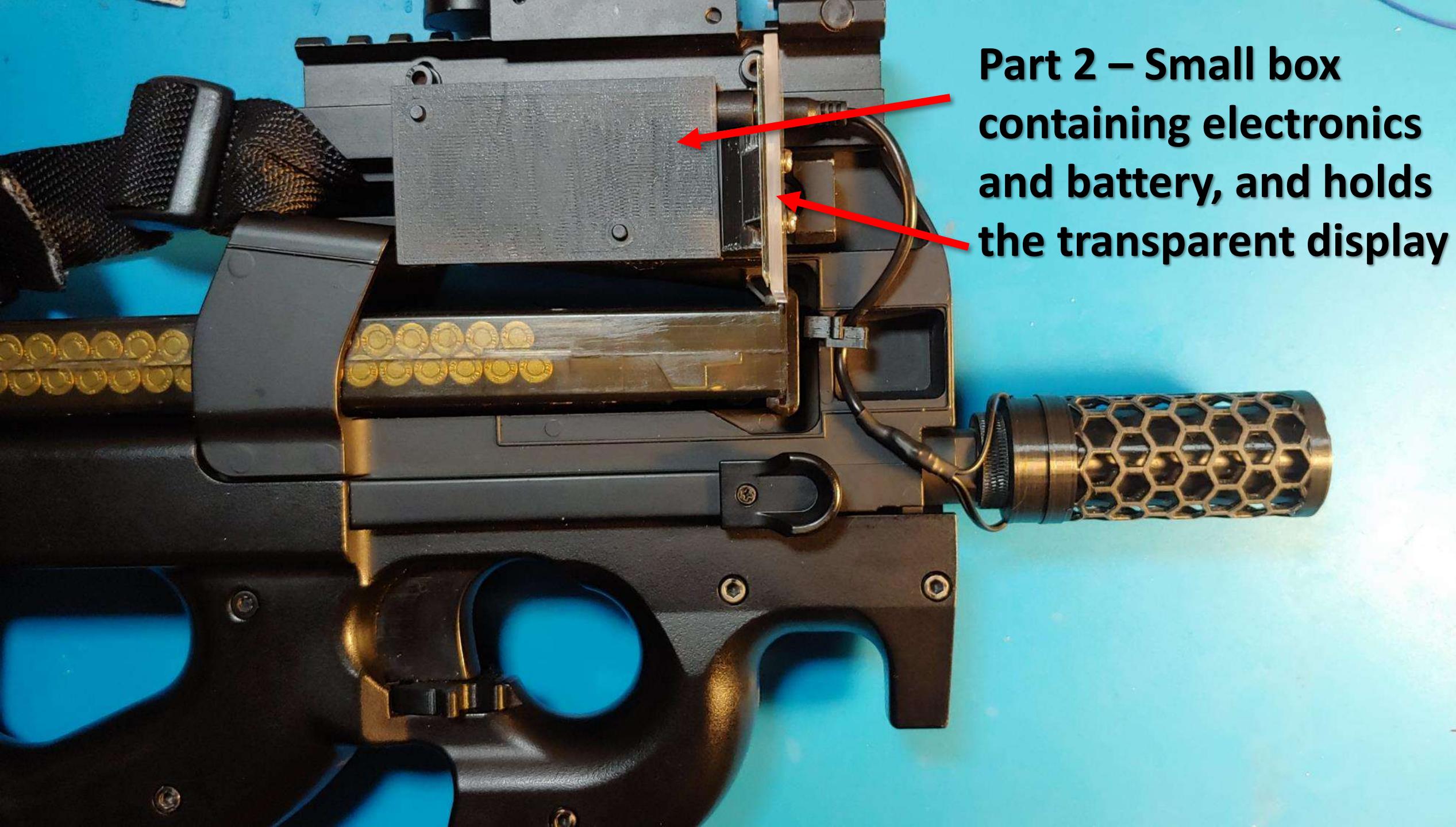
Small wire holes

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





**Clip to keep wires
neatly in place**

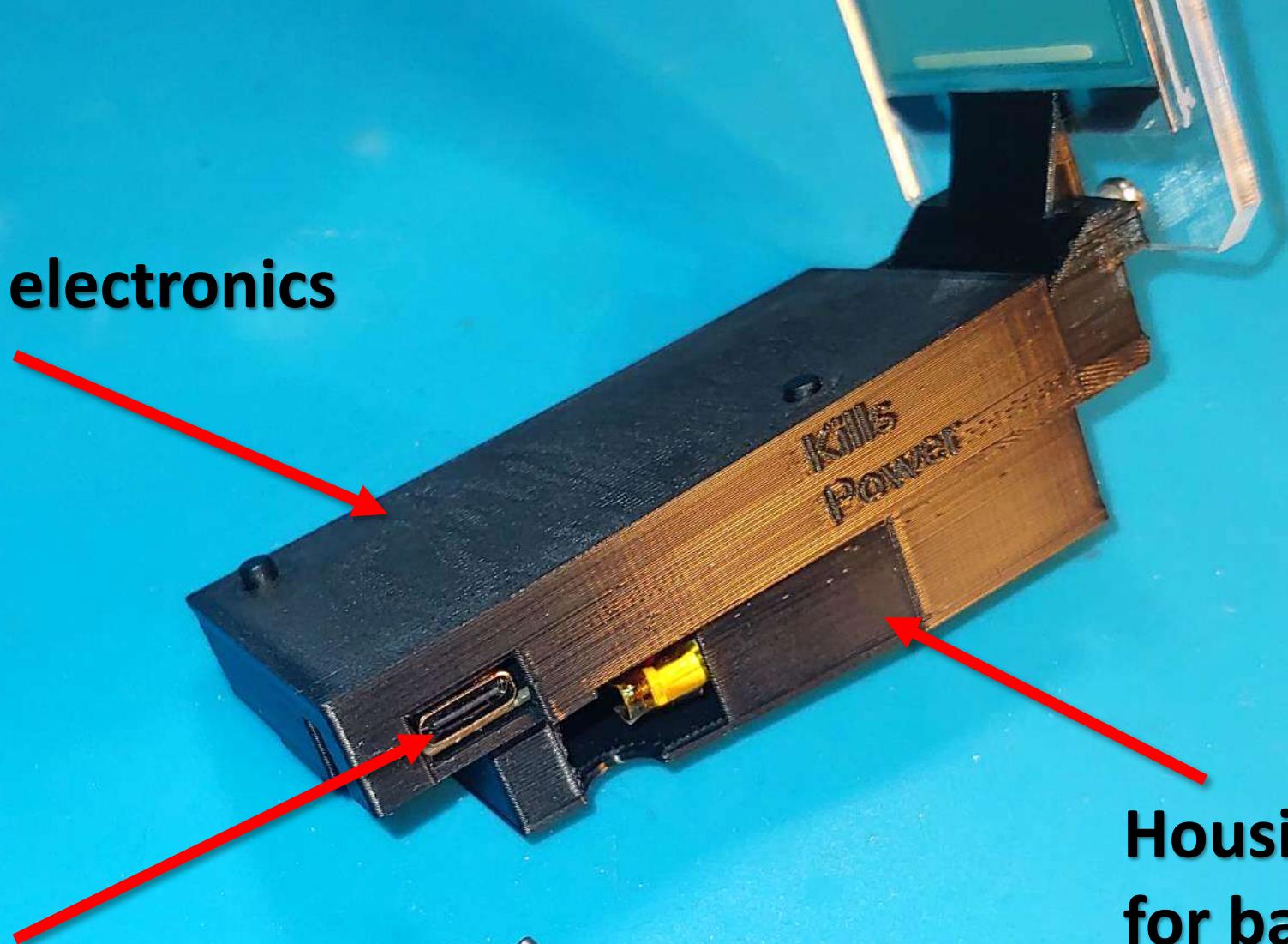


Part 2 – Small box containing electronics and battery, and holds the transparent display



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

Housing for electronics



**Housing
for battery**

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

**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

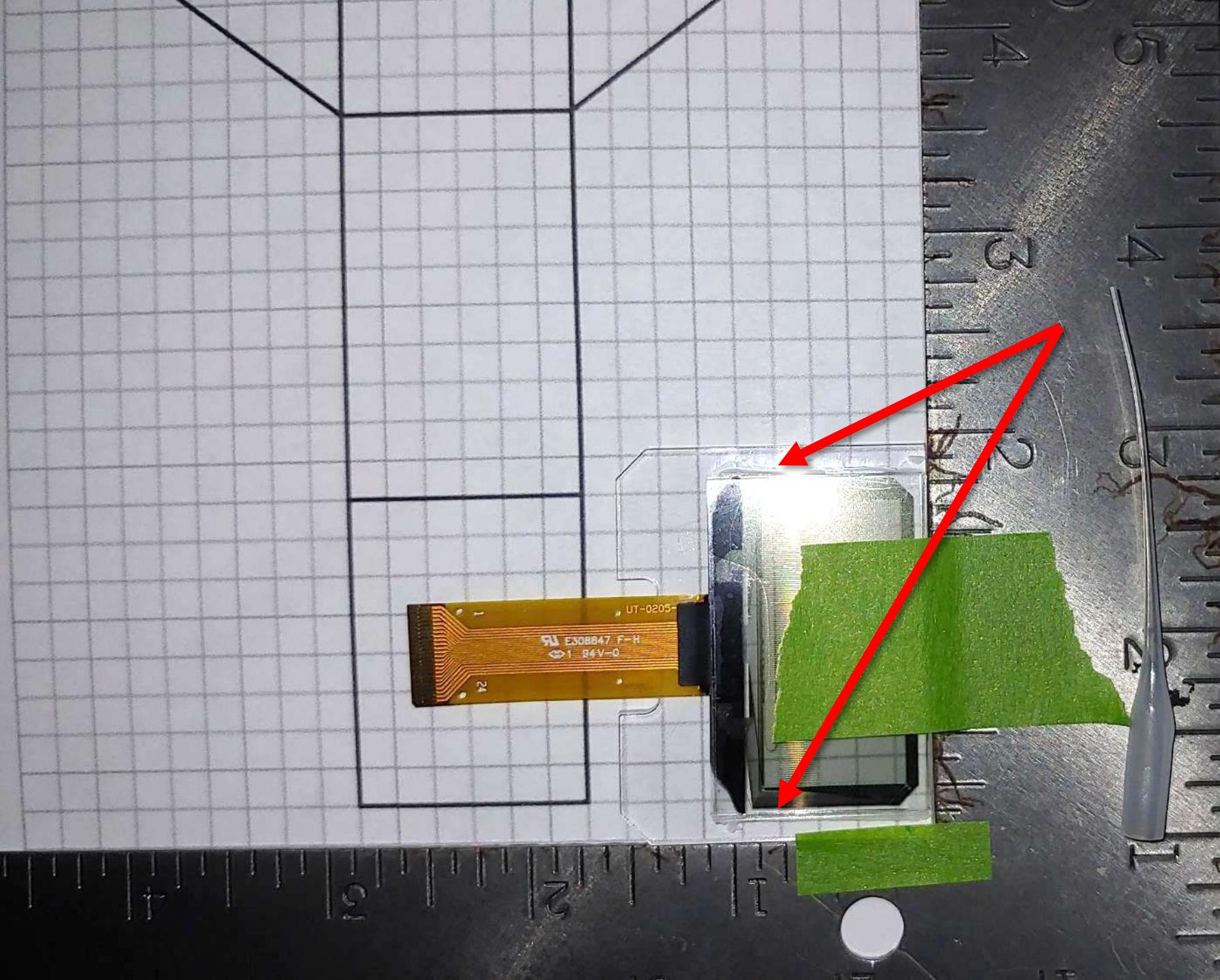
3mm
0.12"

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

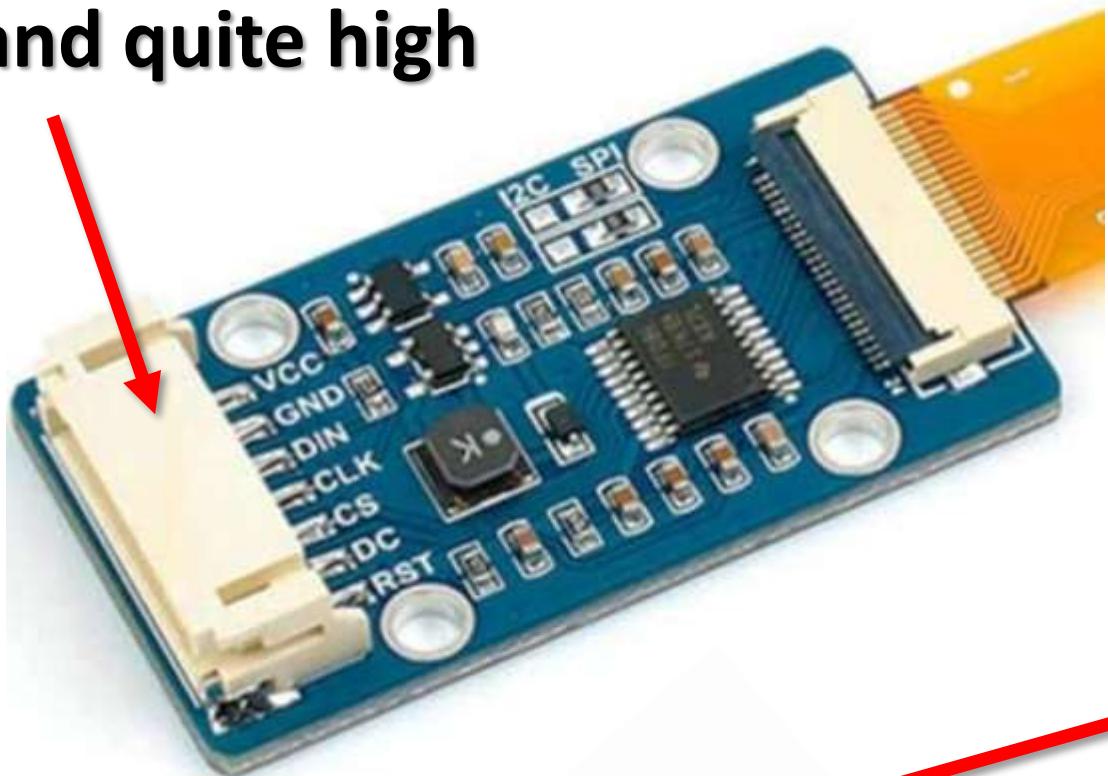
**Push
Buttons**

ESP32-C3

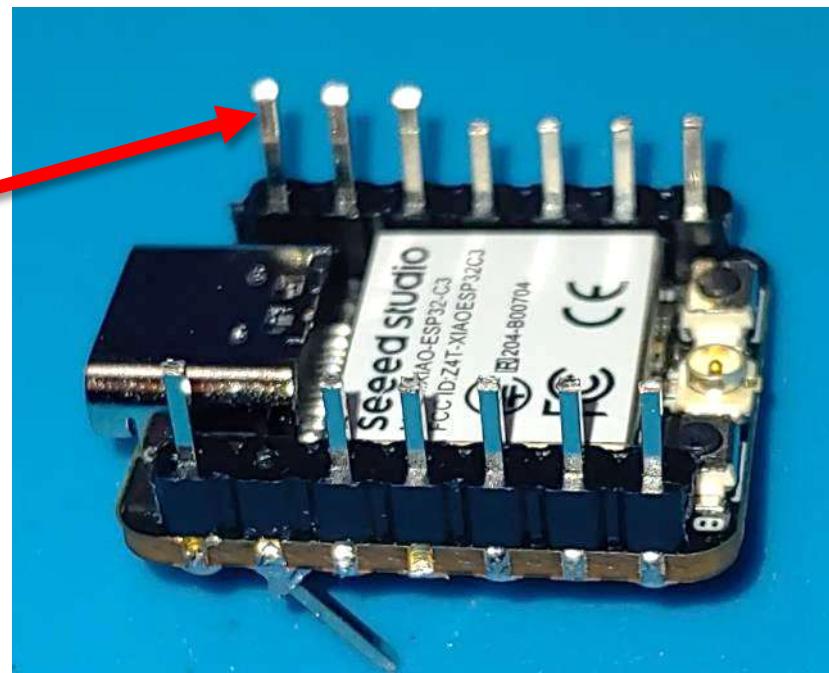
Display driver board

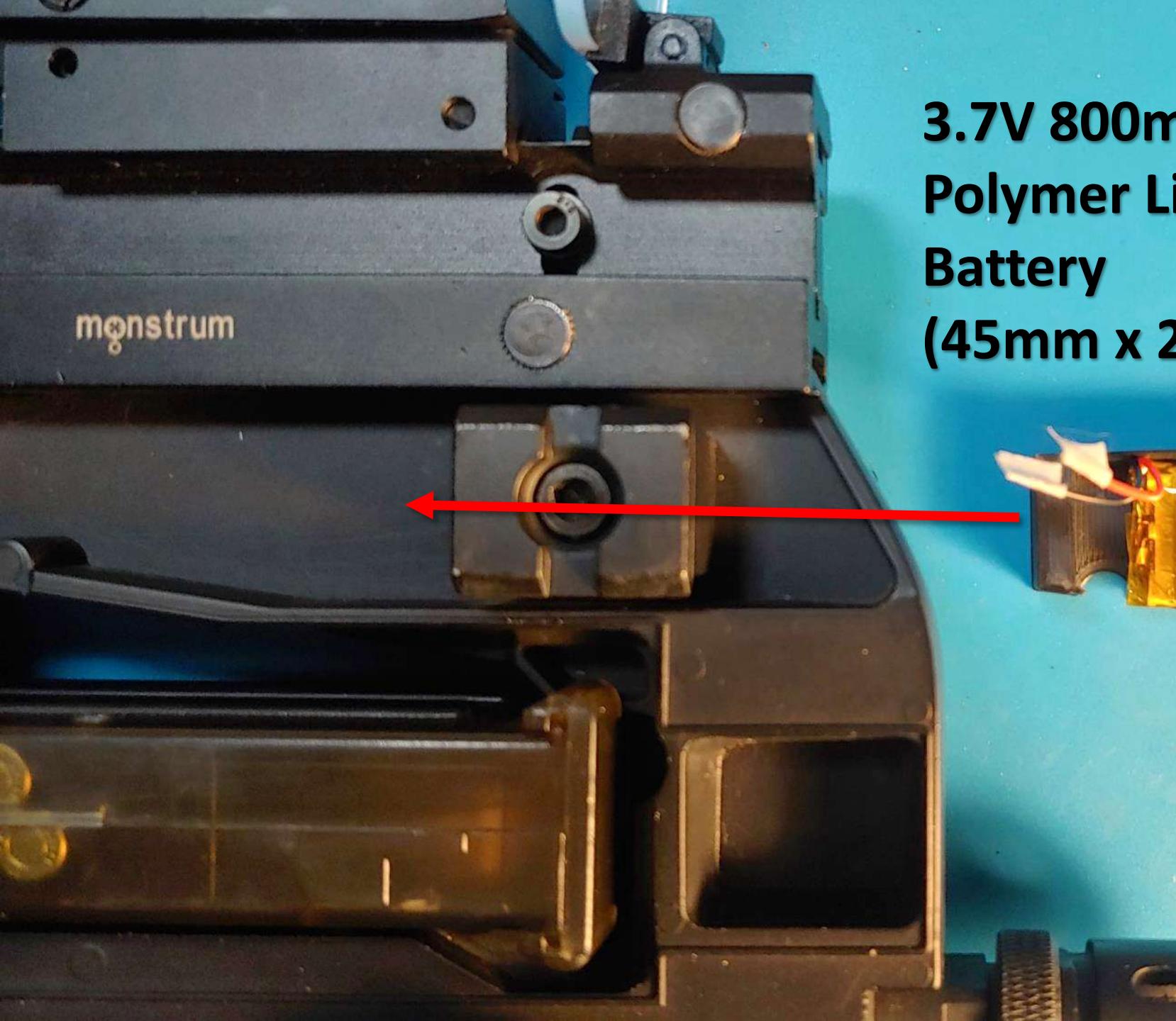
**Display and
plexiglass**

**Connector difficult to remove
and quite high**

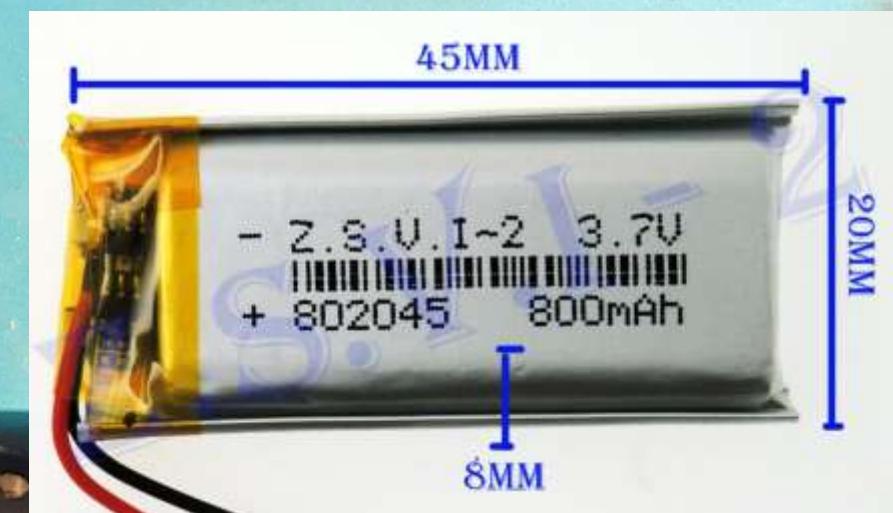


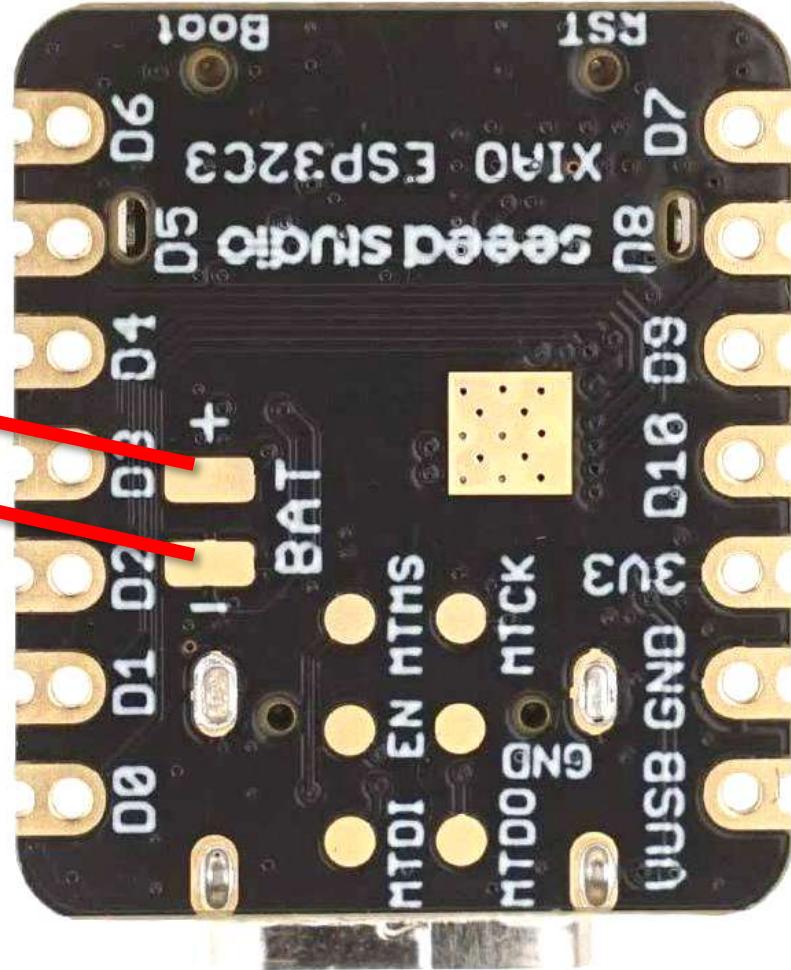
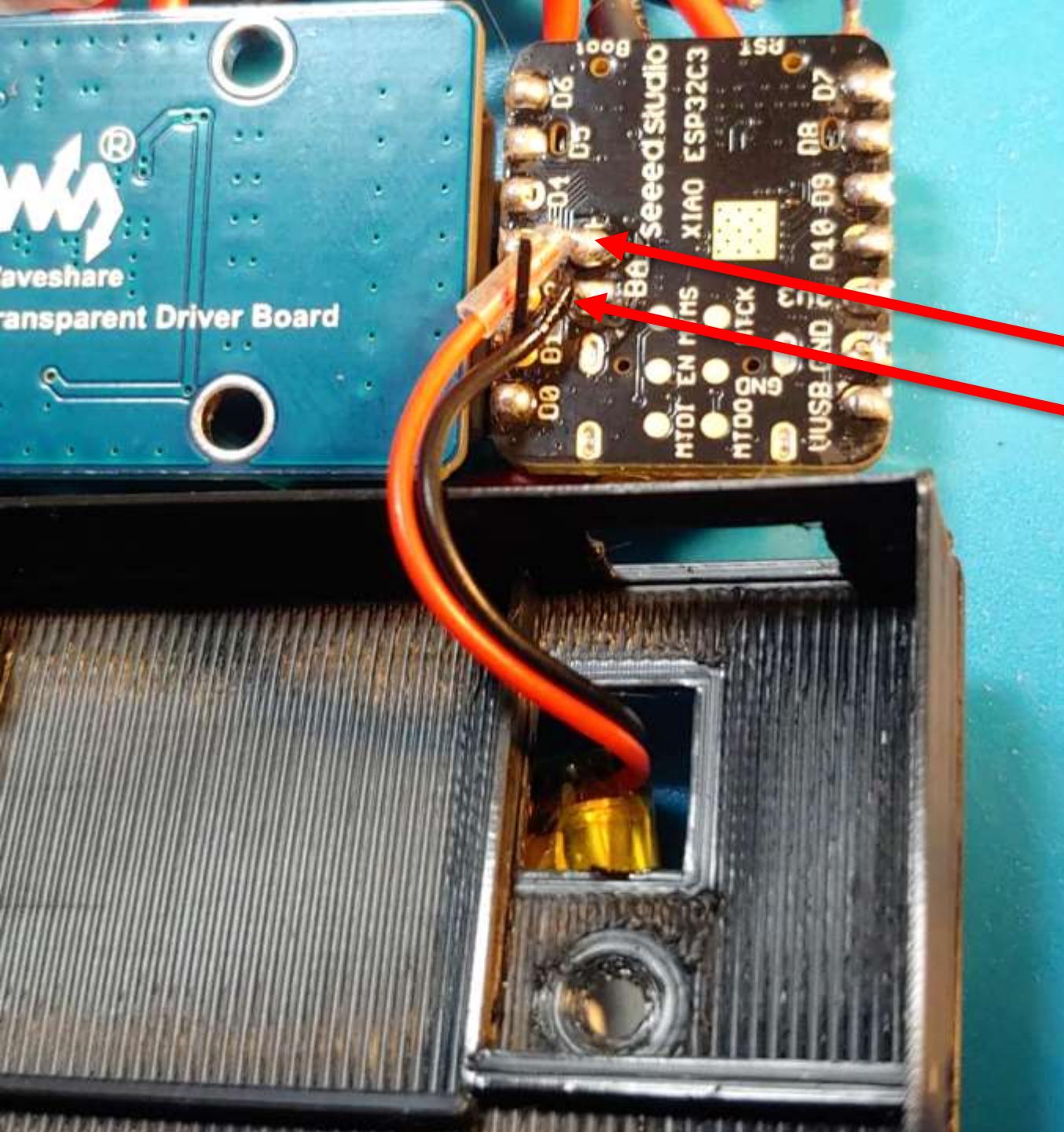
**Solder breadboard pin
header strip upside down,
long part pointing upward,
for wires to easily reach over
high connector**





**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!



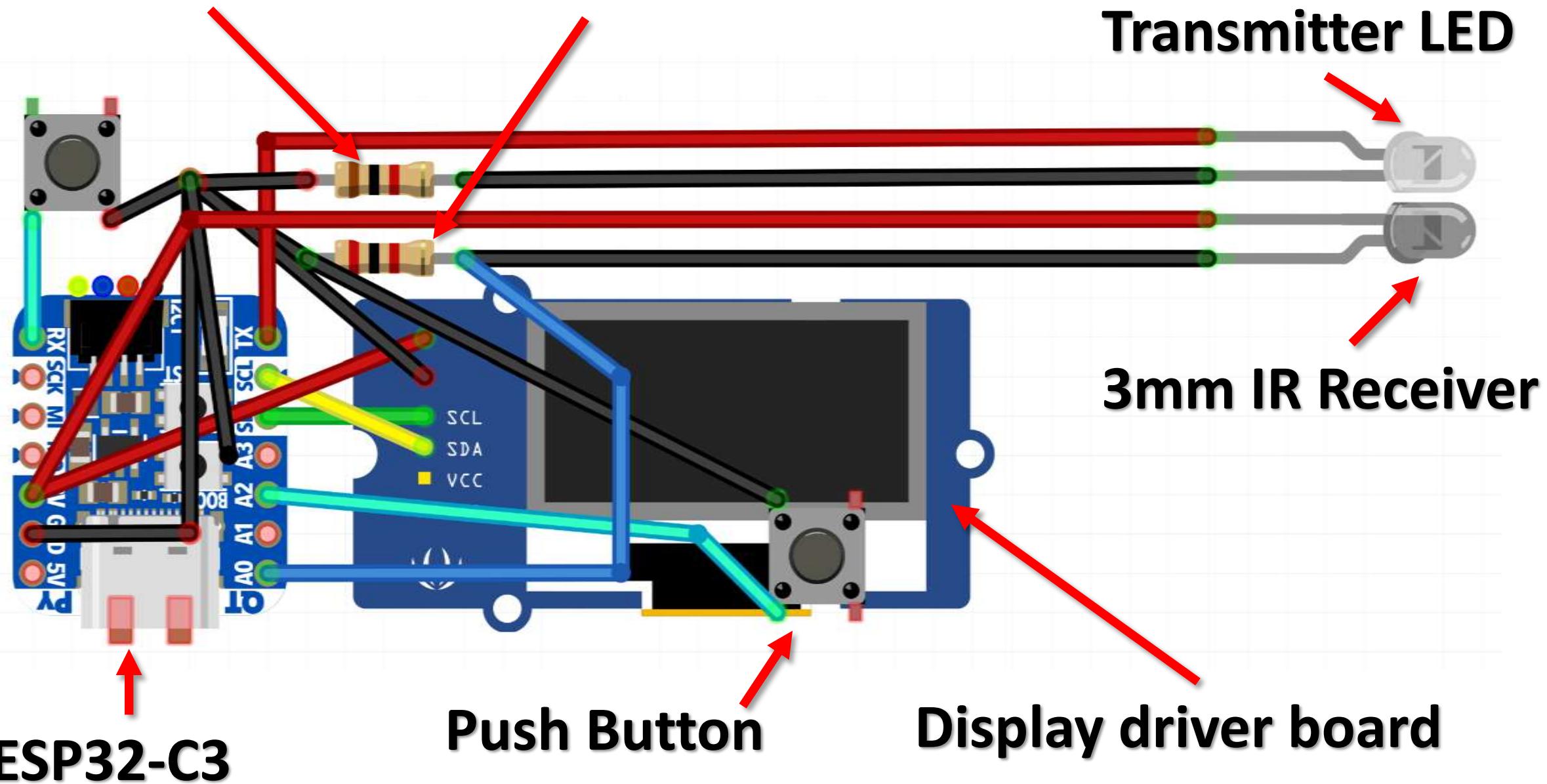
Arduino Programming

- 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

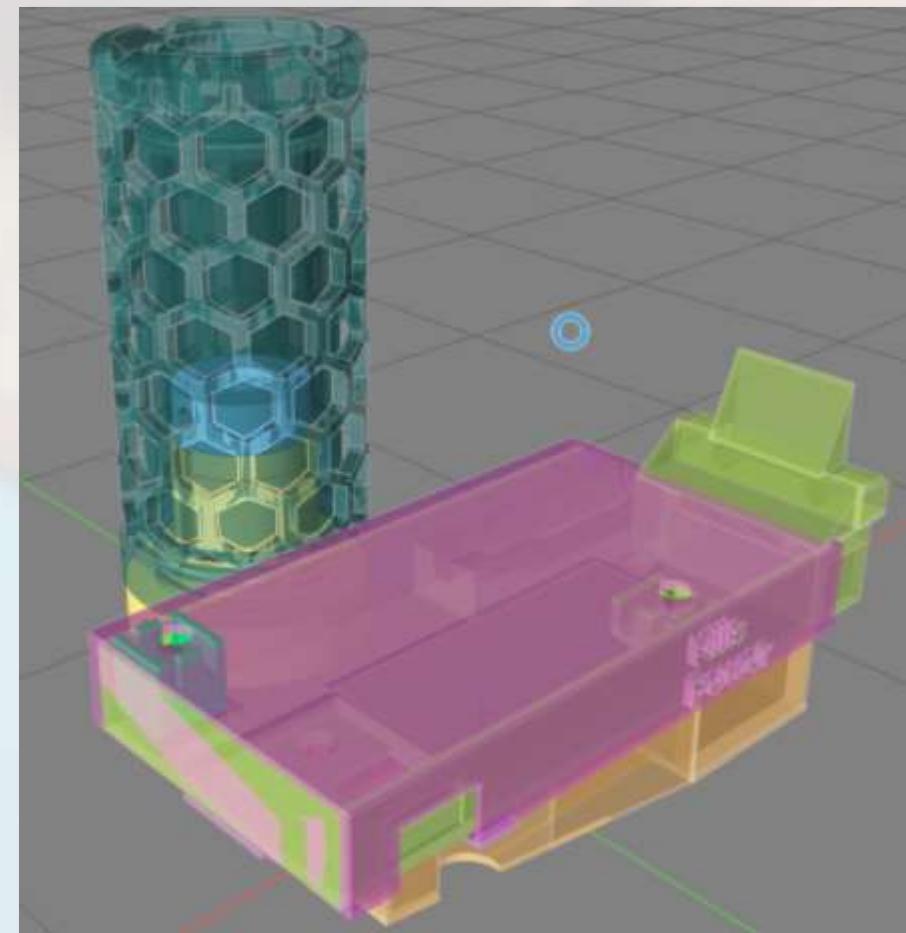
- [XIAO ESP32-C3](#)
- [SSD1309 Transparent OLED Display](#)
- [3.7V 800mAh 802045 Lithium Polymer LiPo Rechargeable Battery](#)
- [3mm IR Transmitter LED and IR Receiver](#)
- [2.5mm thick plexiglass](#)
- [Transparent Glass/Acrylic glue](#)
- [Clear film cellphone screen protector](#)
- [Momentary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

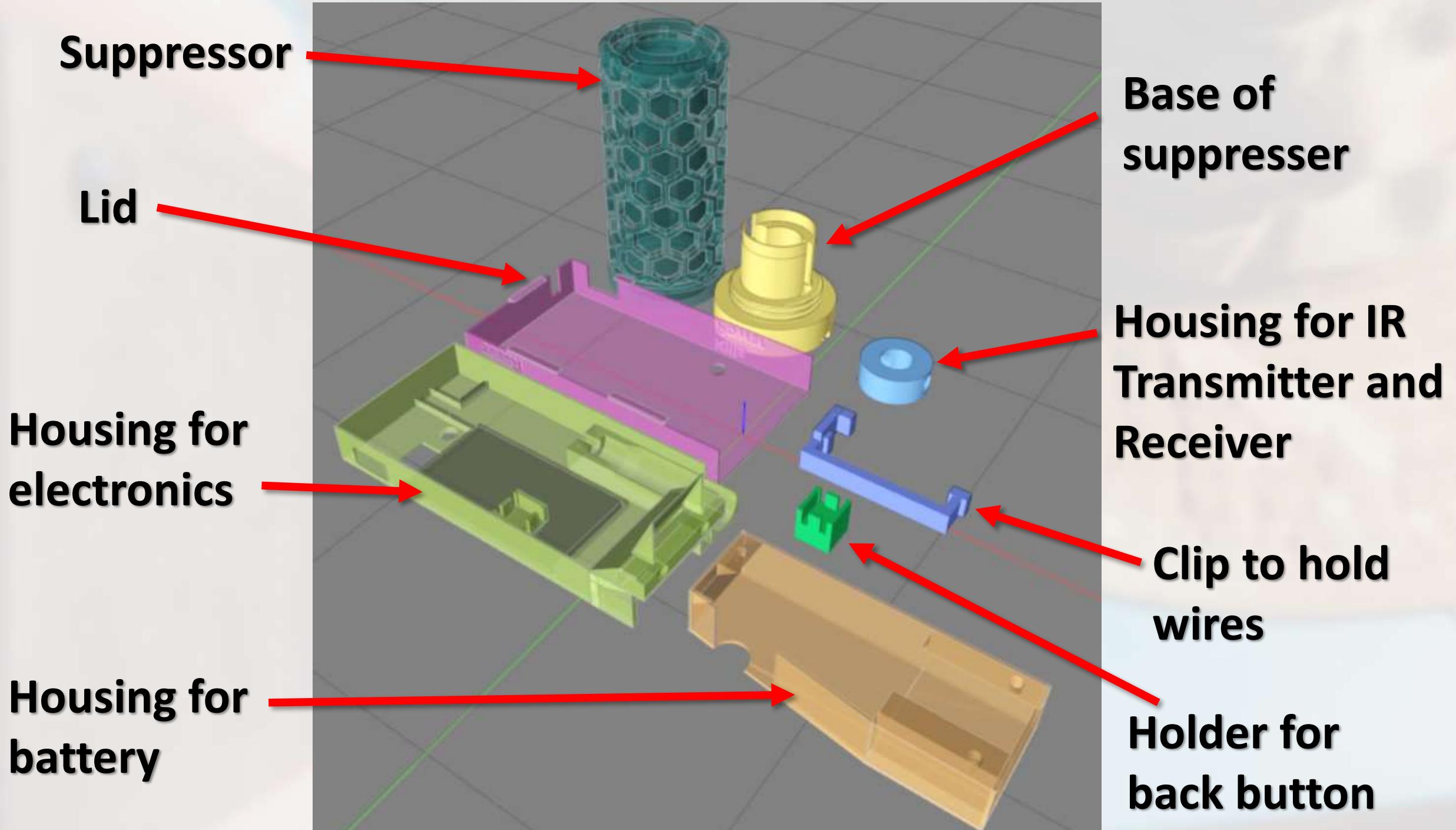
3D Printing

- 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

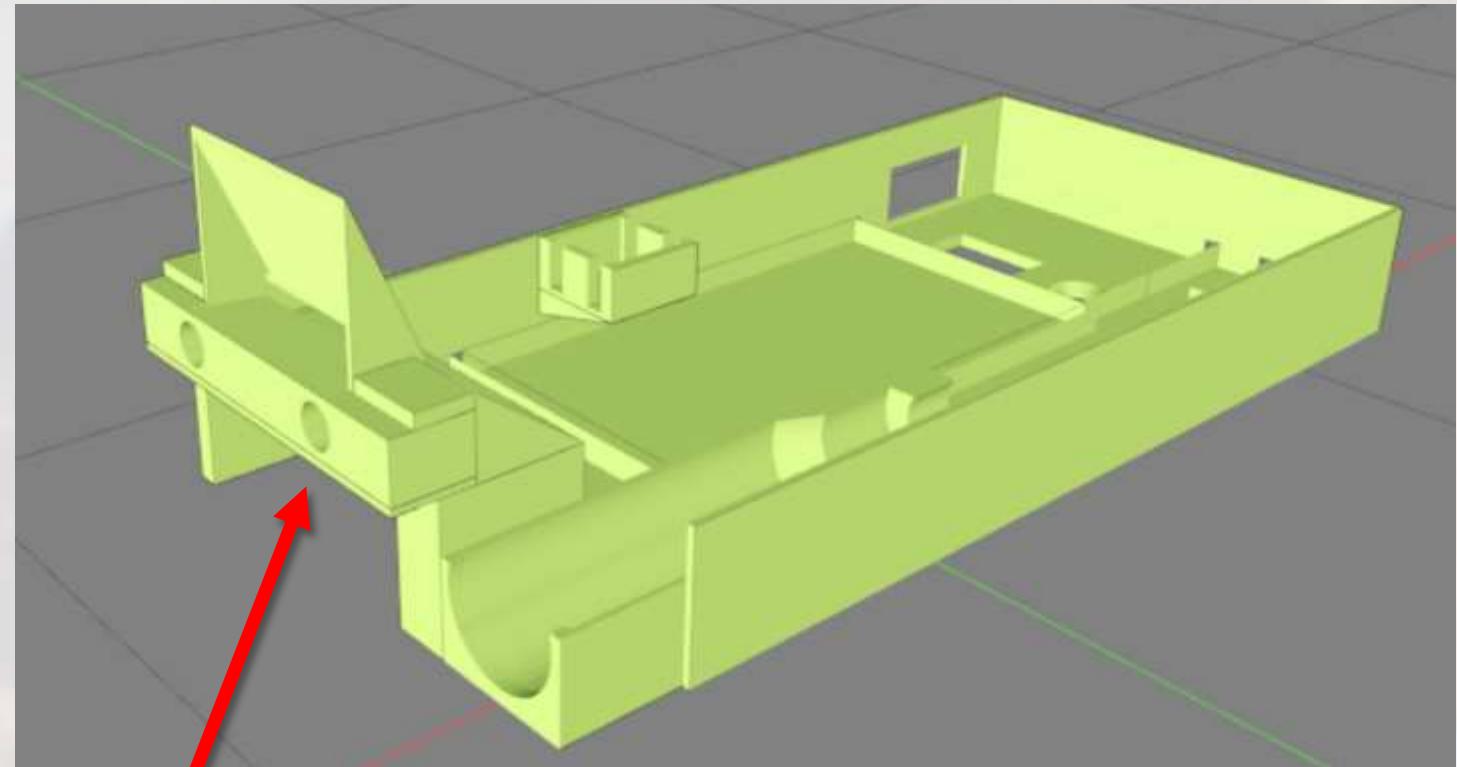
Putting it together

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



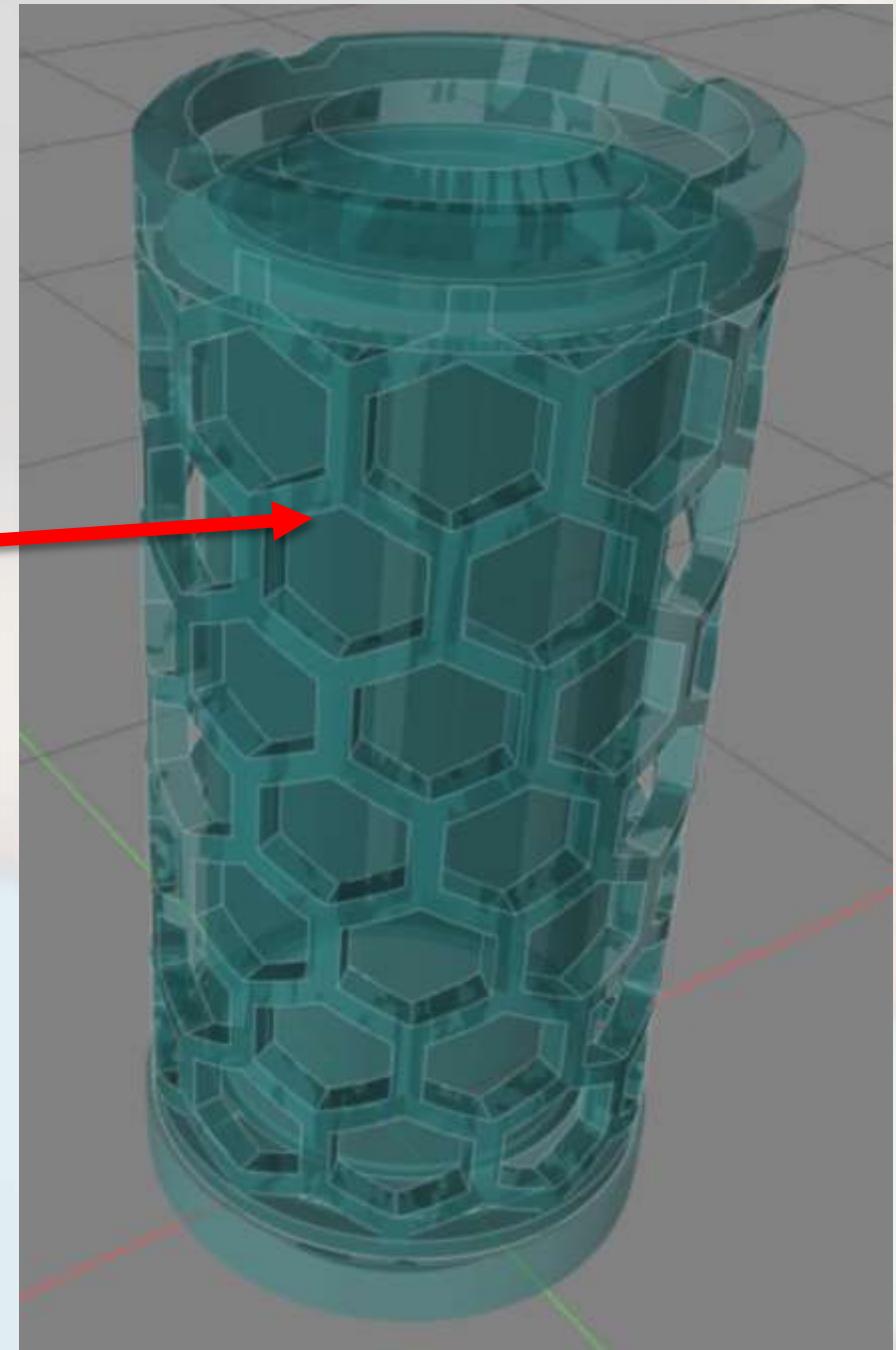


**Only this part needs to
be printed with
supports**

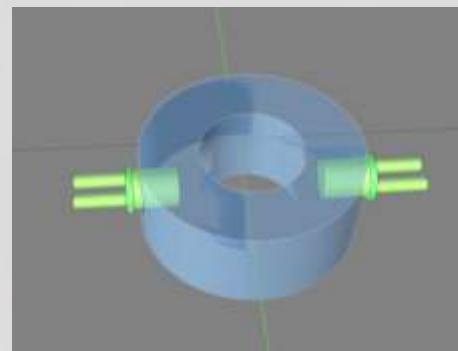


Supports only needed for this overhang

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

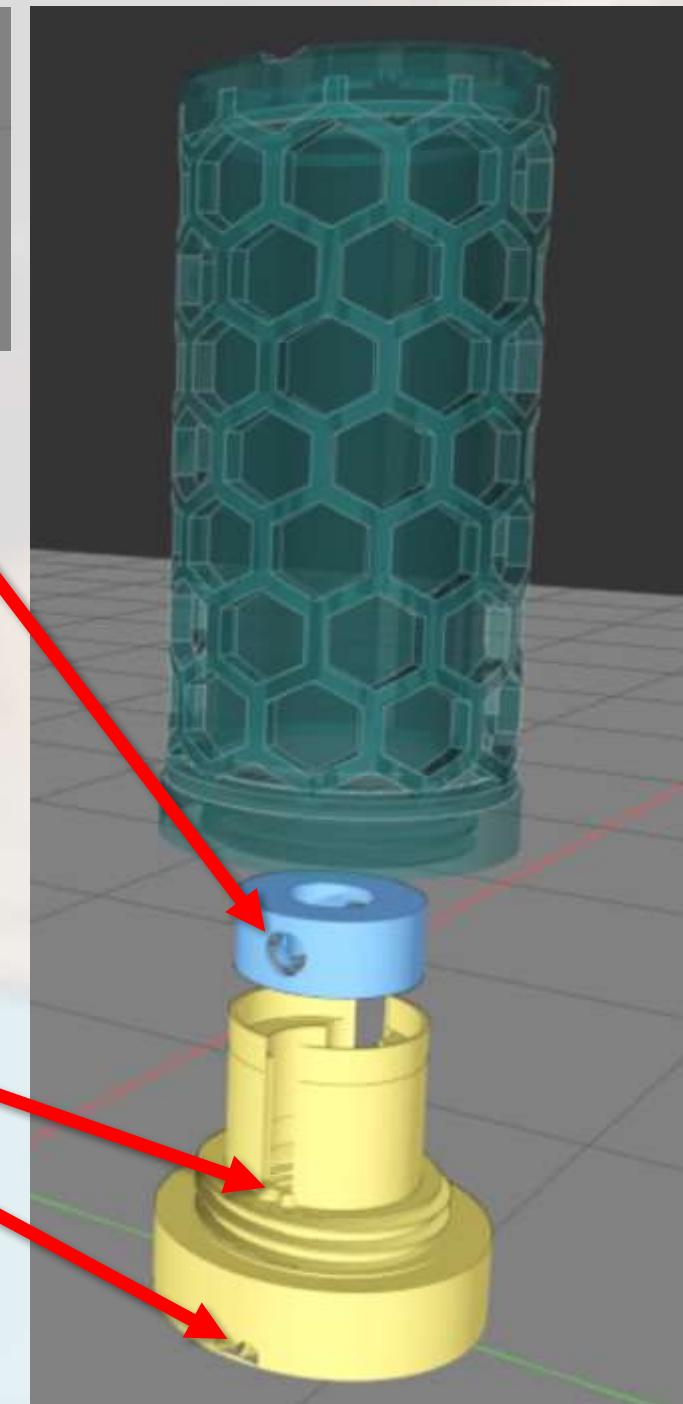


Slide IR Transmitter and Receivers into these holes. Then solder thin wires to IR transmitter and receiver. Remember to isolate wires with shrinking tube.

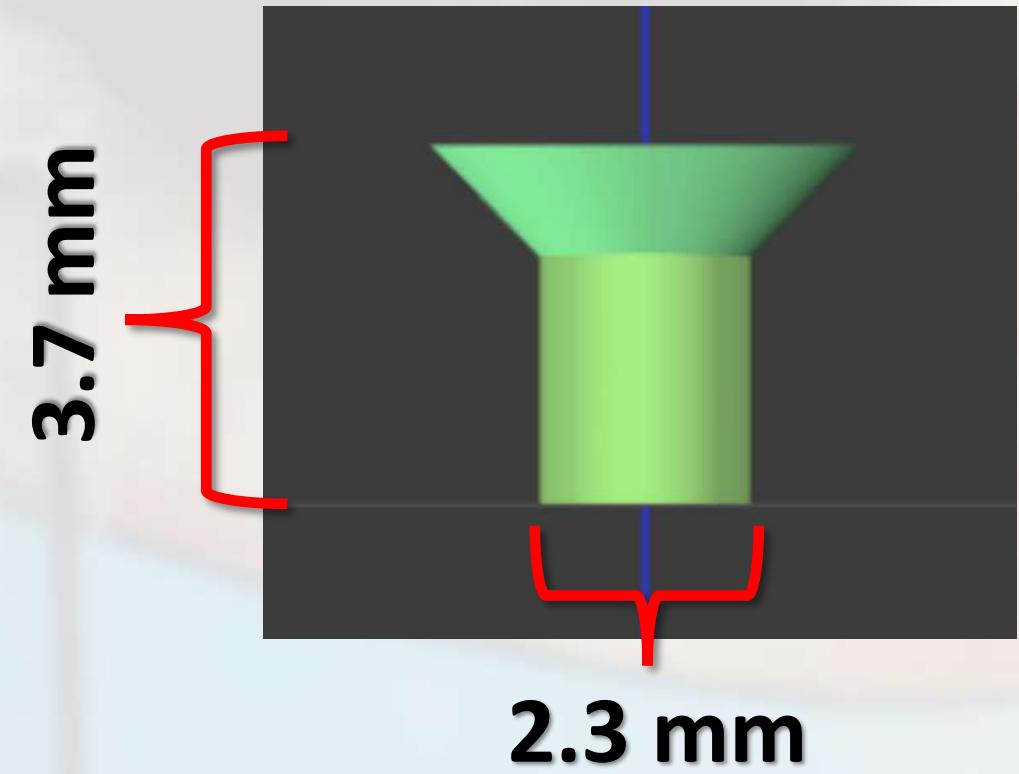
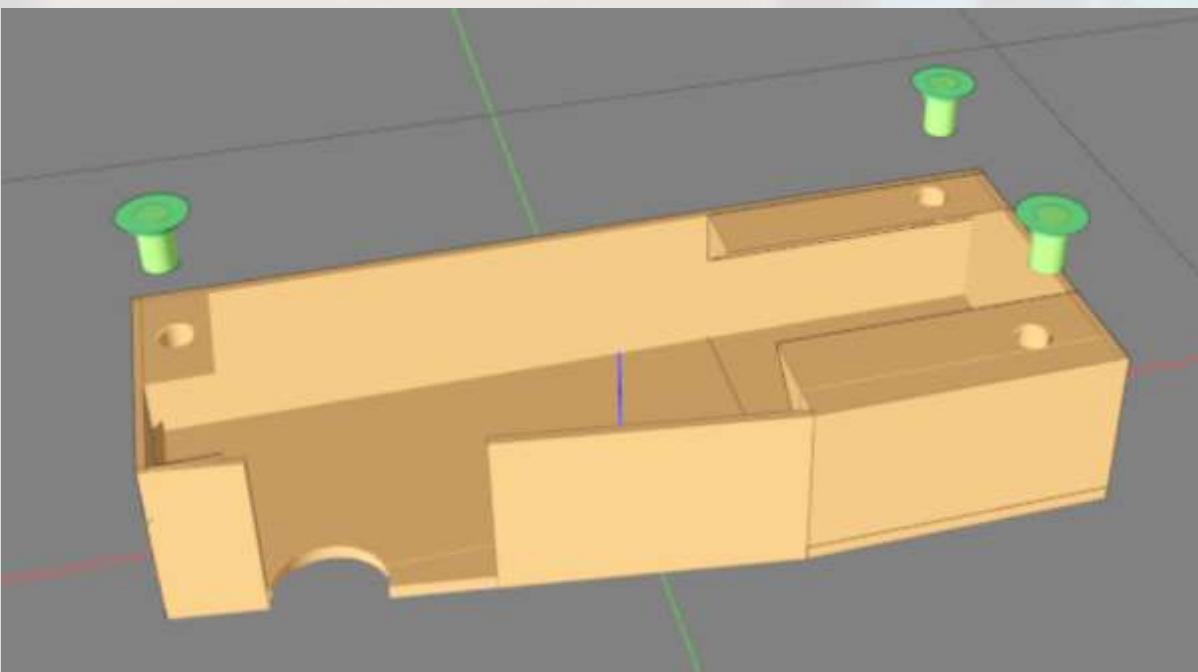


Slide wires through these holes

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

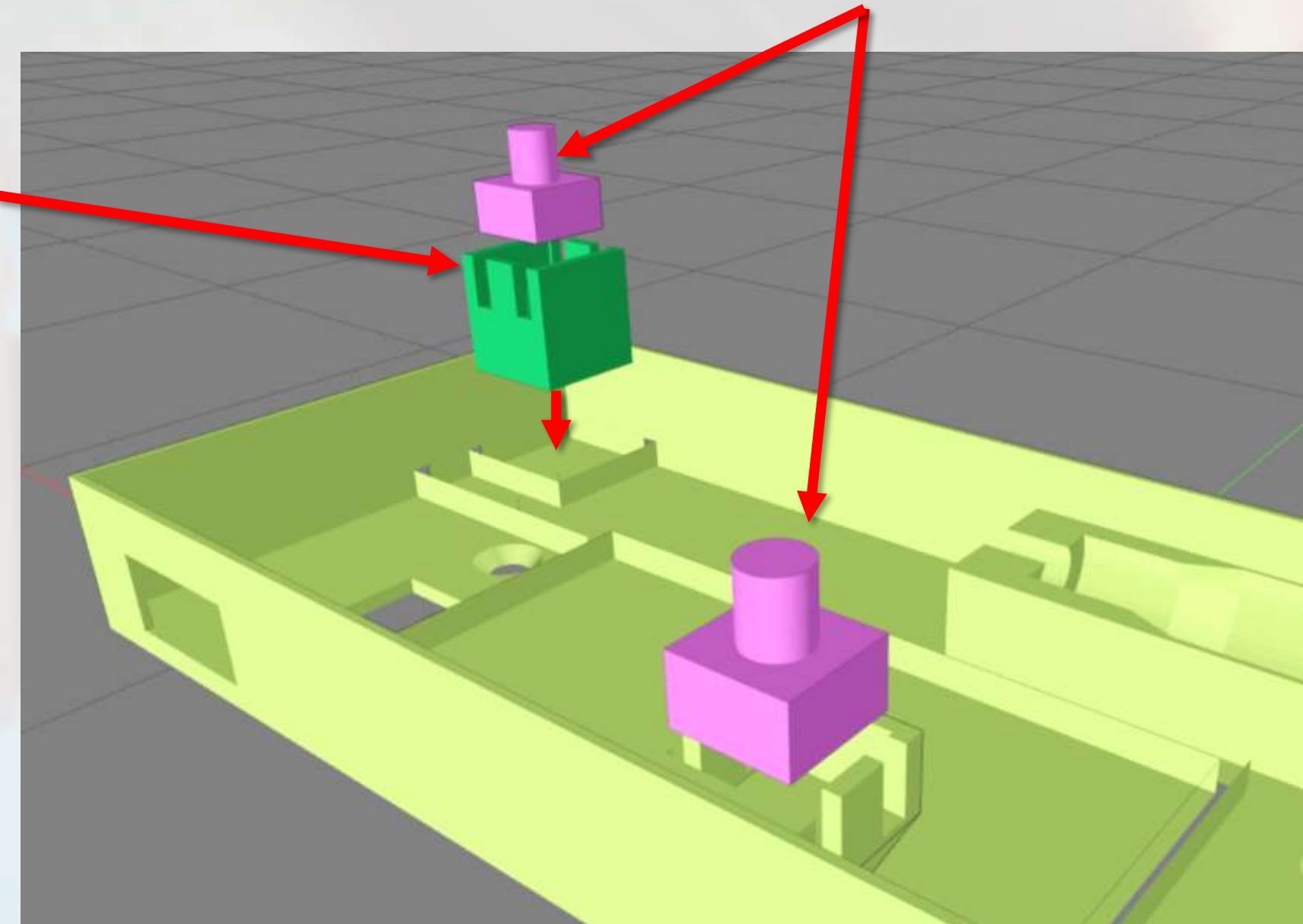


Housing with electronics screws onto the battery housing. Holes fit small mounting screws included with transparent display.

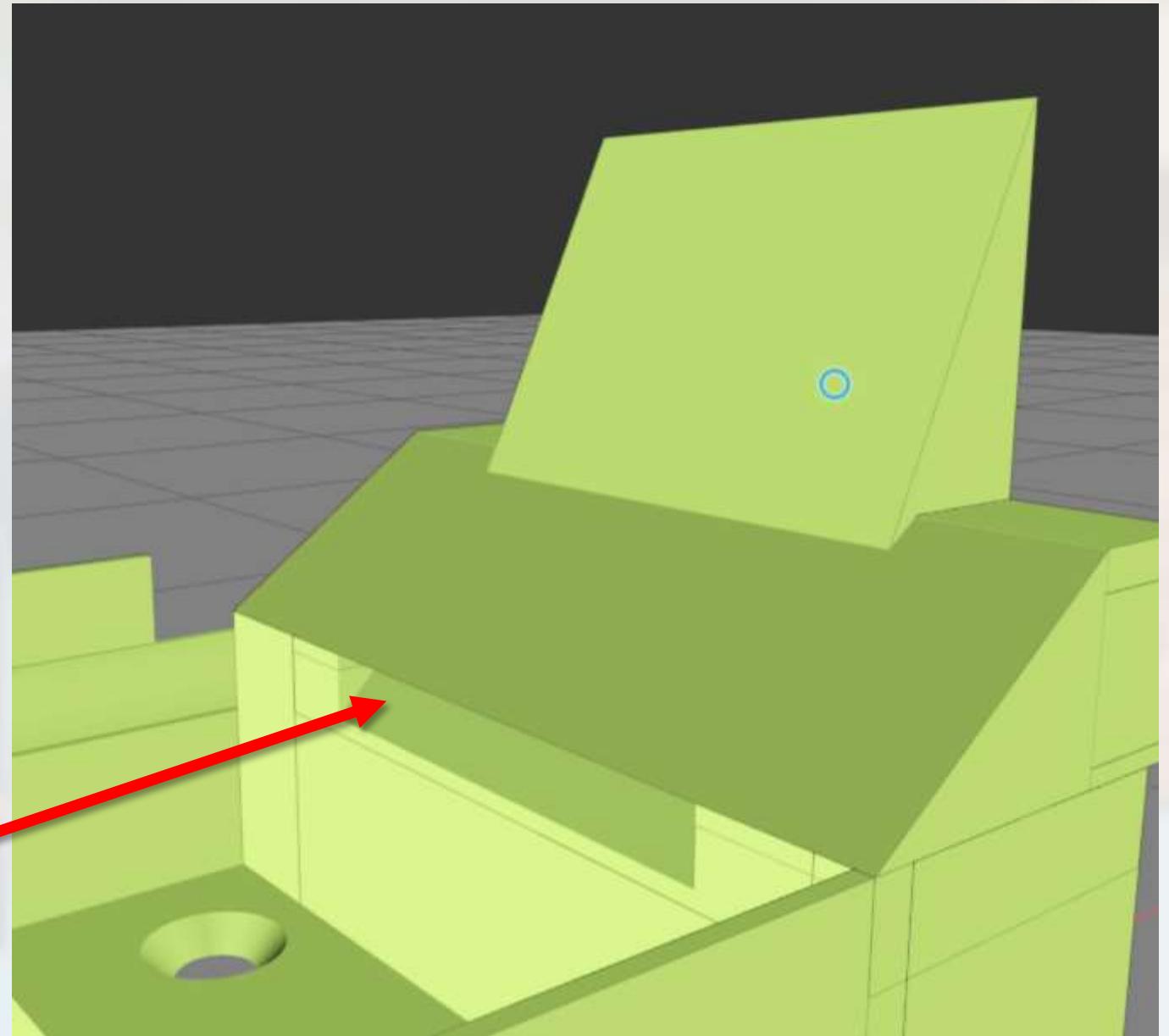


Momentary push buttons

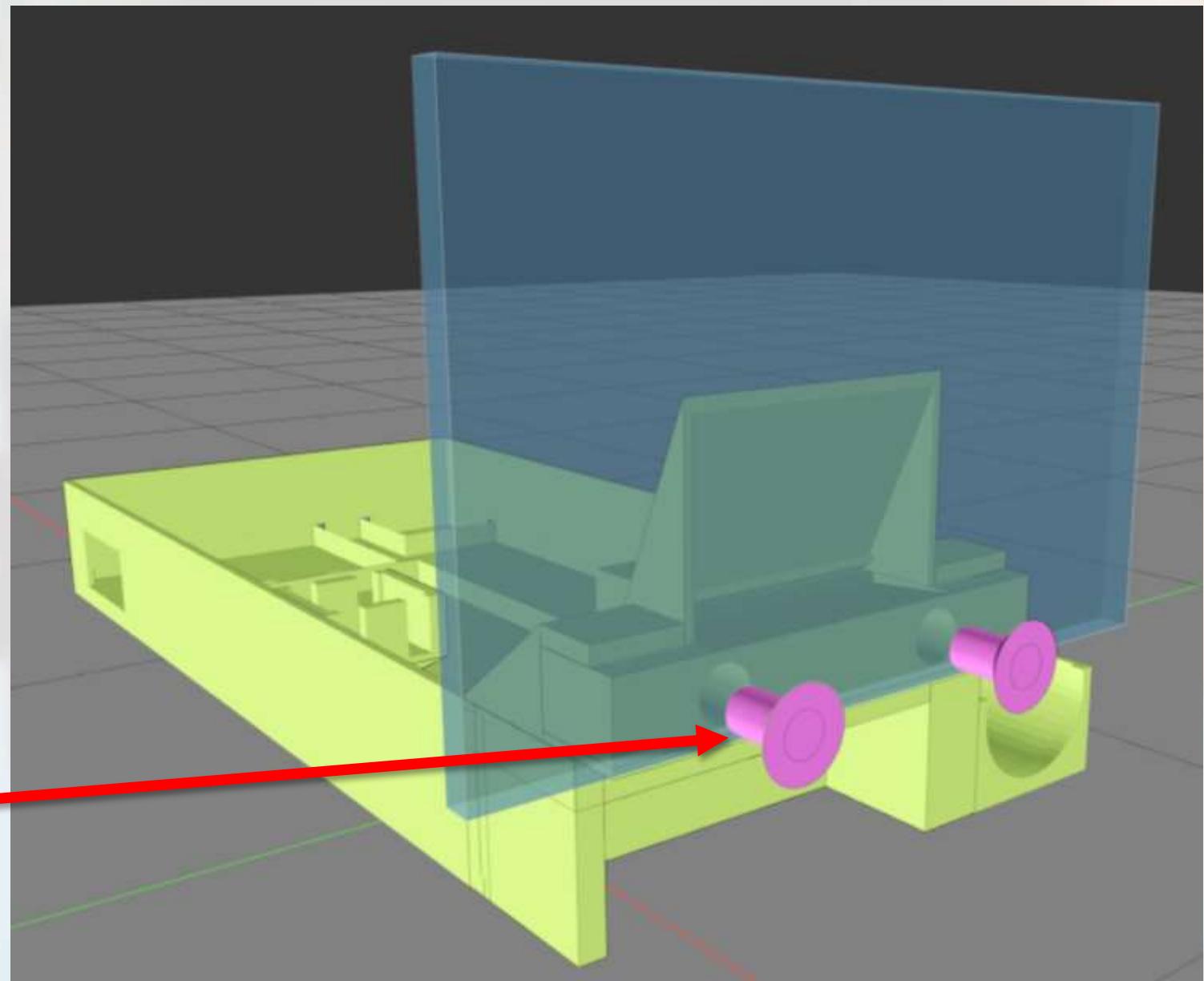
Back button housing
is a separate print. It
just sits in the
cutout in the corner



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



Attach plexiglass with display using M3x8 screws



Programming

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