

# Overdose-Sensing Injector

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# Our Research



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- Background (The Opioid Crisis Data and Statistics)
- Ethical Defense for Device Creation
- Device Placement
- Needle Length for Auto-Injection
- Naloxone Doses
- Testing Procedure

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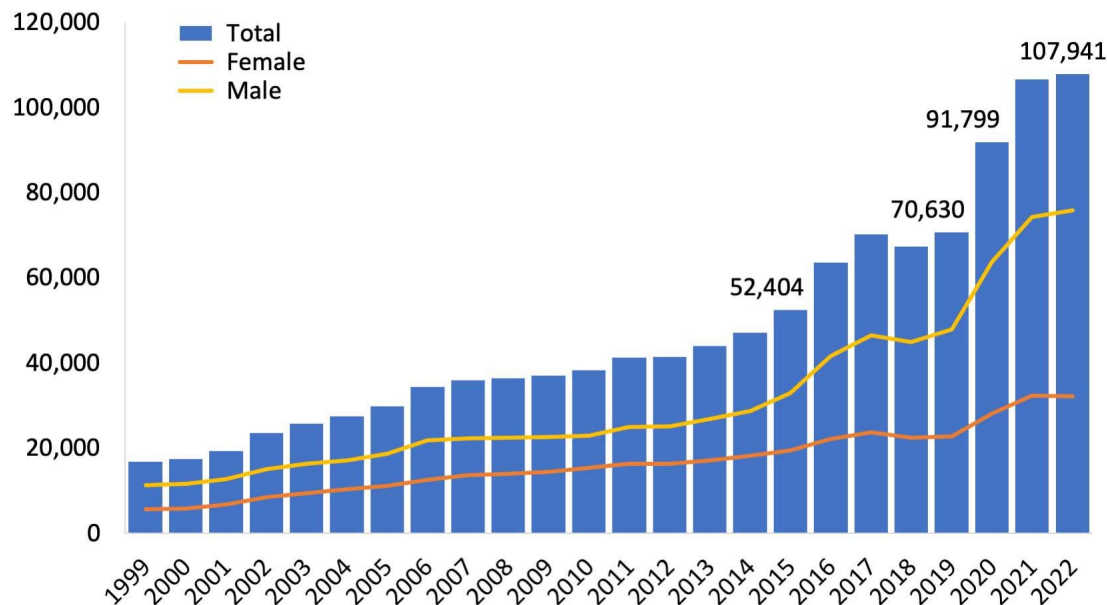
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# Background and Ethics

“Overall, drug overdose deaths rose from 2019 to 2022 with 107,941 drug overdose deaths reported in 2022. Deaths involving synthetic opioids other than methadone (primarily fentanyl) continued to rise with 73,838 overdose deaths reported in 2022.”

*Drug Overdose Death Rates* | National Institute on Drug Abuse. (2024, May 30).  
National Institute on Drug Abuse.  
<https://nida.nih.gov/research-topics/trends-statistics/overdose-death-rates>

Figure 1. National Drug Overdose Deaths\*, Number Among All Ages, by Sex, 1999-2022



\*Includes deaths with underlying causes of unintentional drug poisoning (X40–X44), suicide drug poisoning (X60–X64), homicide drug poisoning (X85), or drug poisoning of undetermined intent (Y10–Y14), as coded in the International Classification of Diseases, 10th Revision. Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2022 on CDC WONDER Online Database, released 4/2024.

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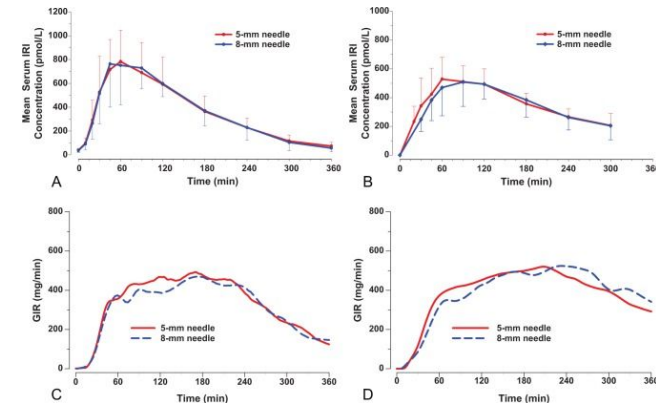
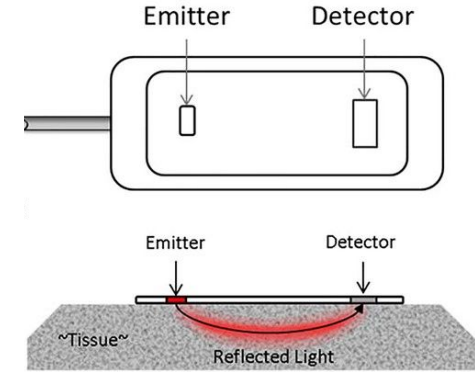
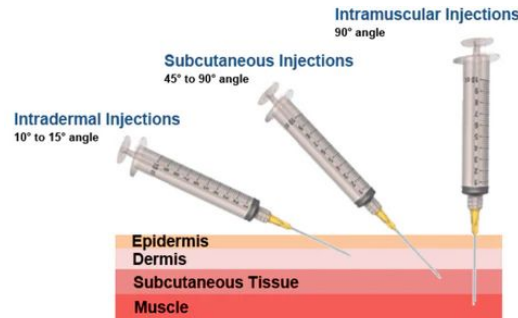
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# Device Placement and Needle Length

- "The performance of reflectance pulse oximetry measured at the upper arm during sleep is superior to measurements at the wrist which are perturbed by undesired large fluctuations suspected to be caused by venous blood."
- "The goal of these analyses was to compare the pharmacokinetics (PK) and glucodynamics (GD) of insulin lispro after a 5-mm or an 8-mm injection depth administration"

Chan, E. D., Chan, M. M., & Chan, M. M. (2013). Pulse oximetry: Understanding its basic principles facilitates appreciation of its limitations. *Respiratory Medicine*, 107(6), 789–799. <https://doi.org/10.1016/j.rmed.2013.02.004>

Naloxone (Injection Route). (2024, July 8). <https://www.mayoclinic.org/drugs-supplements/naloxone-injection-route/proper-use/drg-20095285>



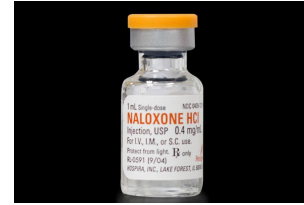
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# Naloxone Doses and Testing Procedure

- Dosing naloxone for our device proved to be a difficult task, but talking with multiple ER doctors and nurses led us to decide that we need multiple cartridges for people experiencing different levels of tolerance to opioids.
- Our testing procedure explored different methods of measuring pulse-oxygen levels including a rented ABG (arterial-blood gas testing device) or using a gold standard pulse oximeter to then calculate testing statistics that could then be presented and approved on an FDA level for approval in the future.





# Our Device



# Design Considerations

## **Low total system power draw**

- Hardware based interrupts
- Low power modes
- High efficiency power supplies

## **High accuracy**

- Low voltage ripple power supplies
- Decoupling and bypass capacitors
- Low pass filters

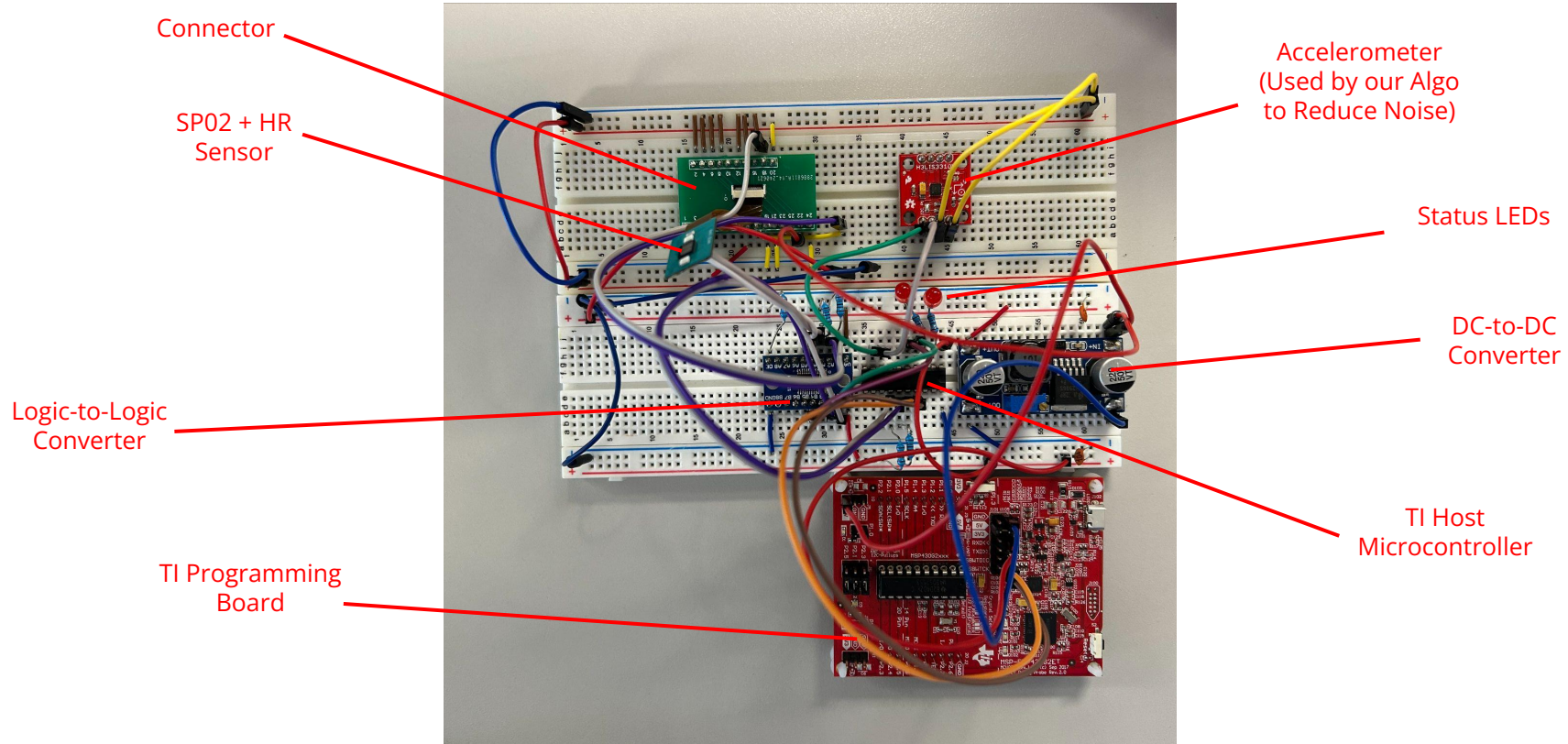
## **Small overall size**

- Small surface mount component packages (QFN, DSBGA, SOT23-5)
- Efficient heat dissipation

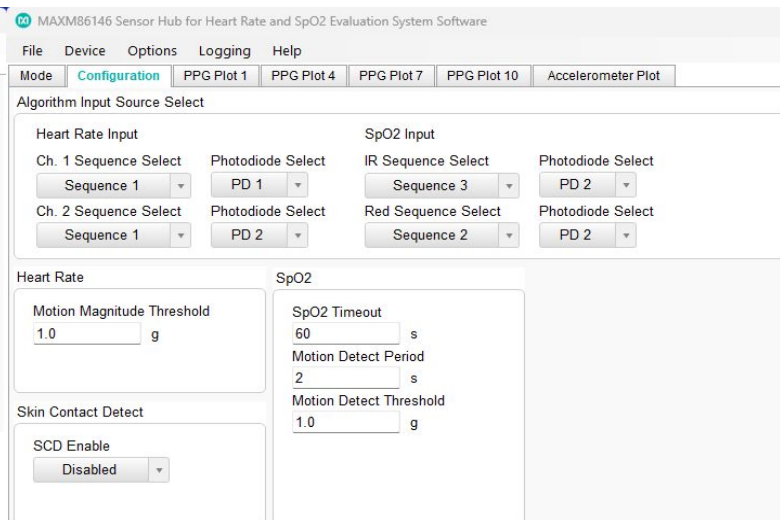
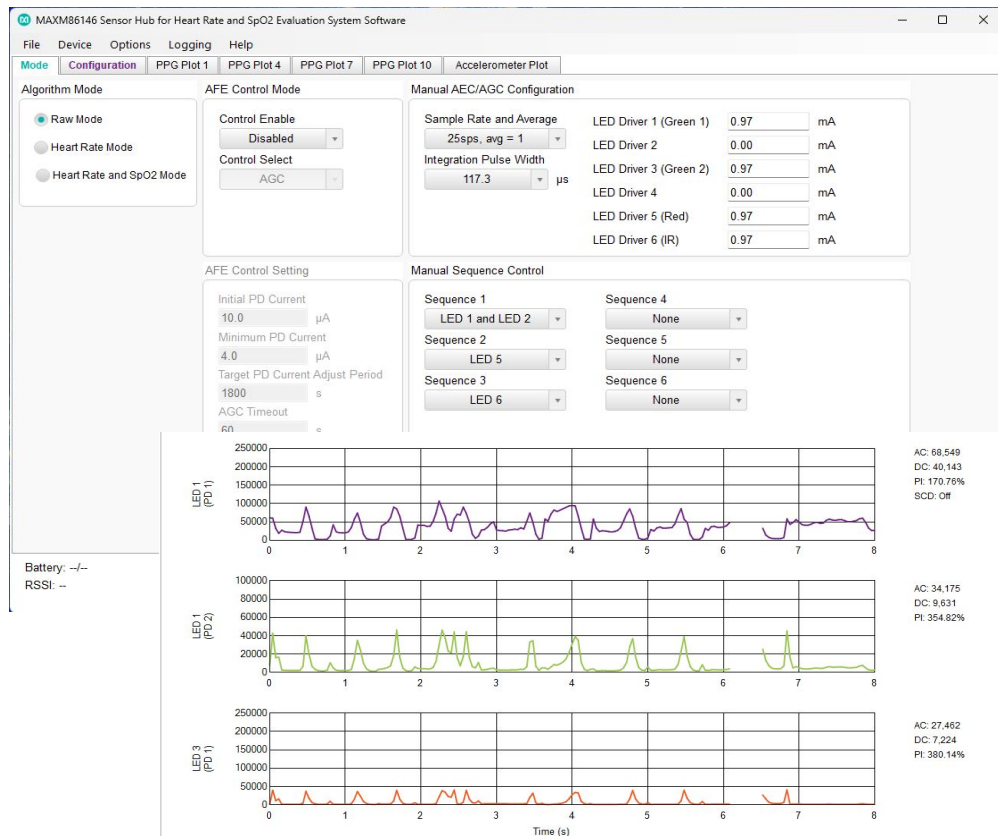
## **Low cost**

- Well known and common components and manufacturers
- Informed tradeoffs among other considerations

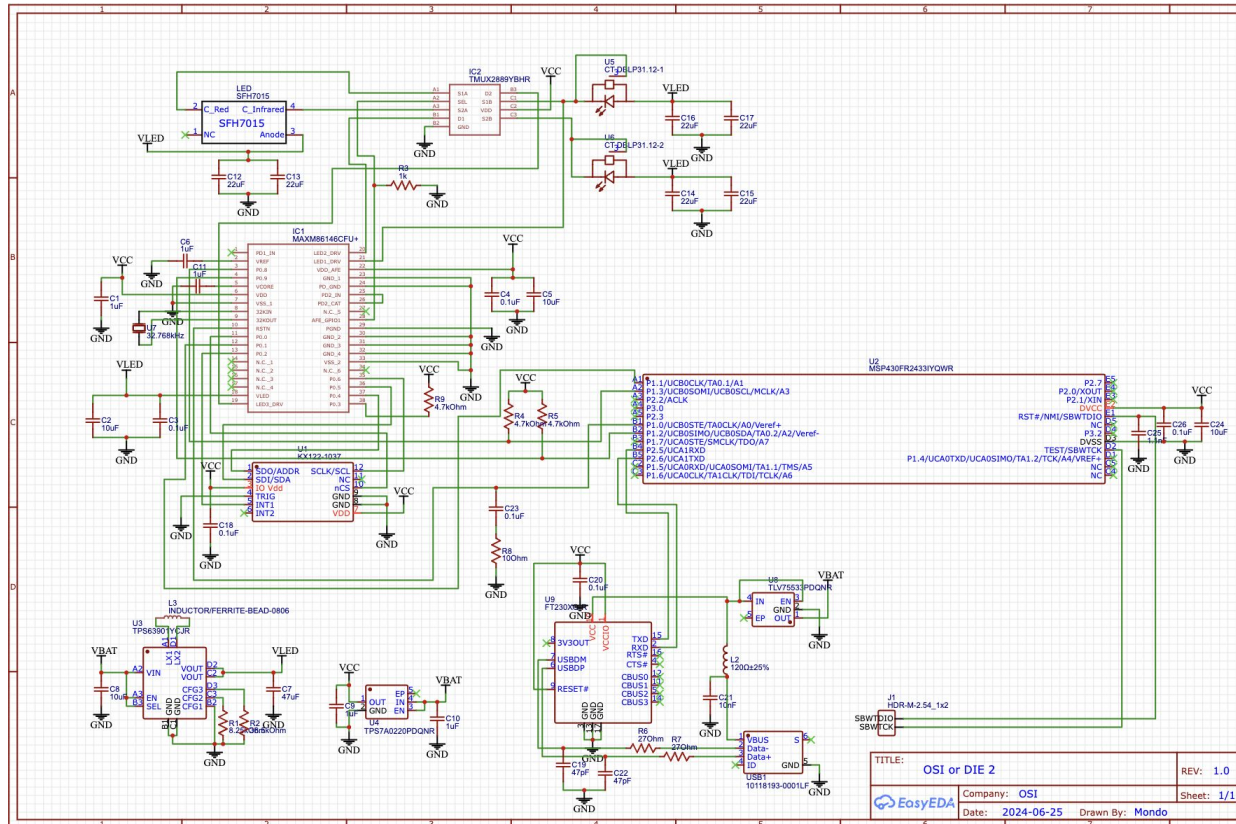
# Prototype Mk.1 (Breadboard Iteration)



# Prototype Mk.1 (Calibration)

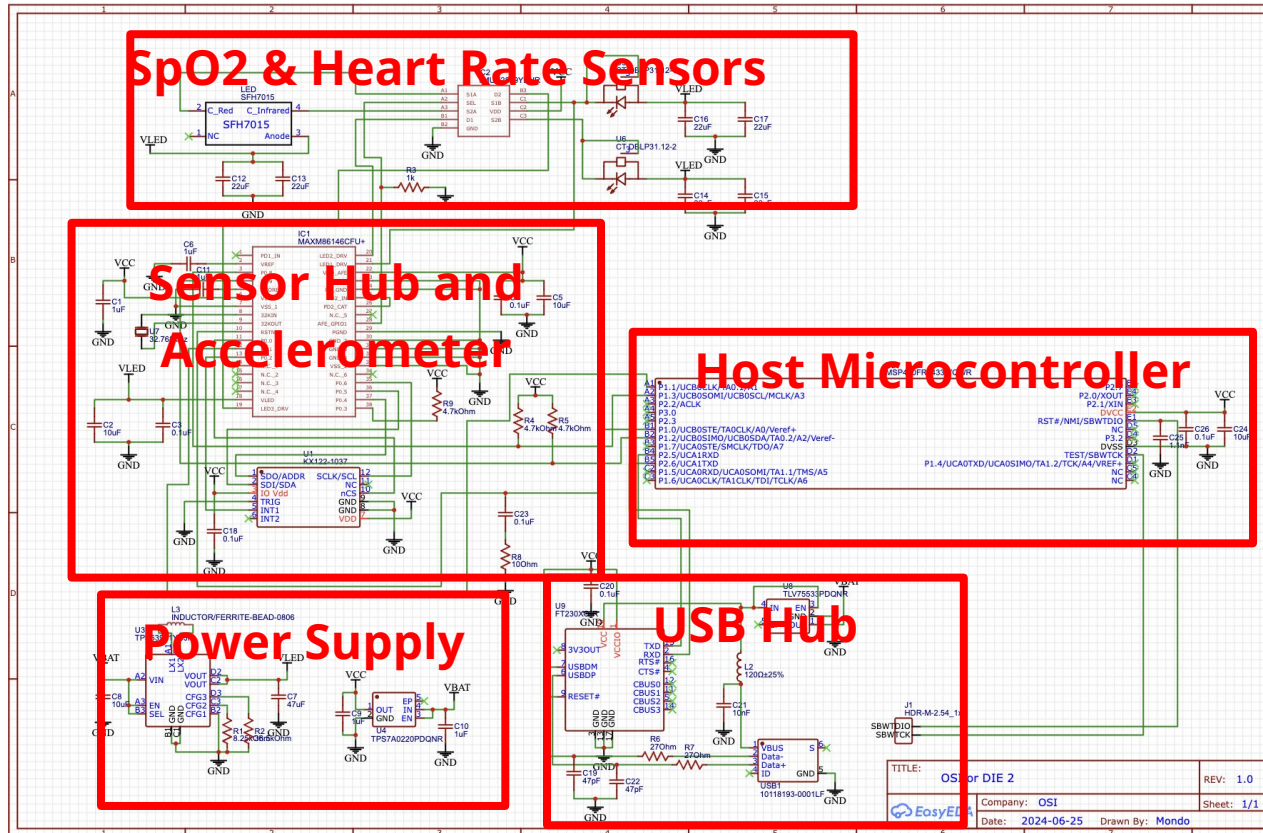


# Prototype Mk.2

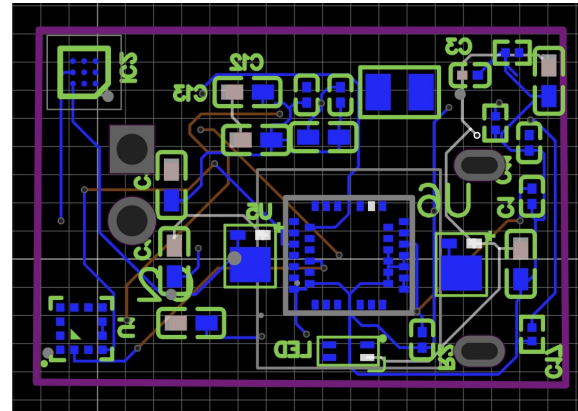
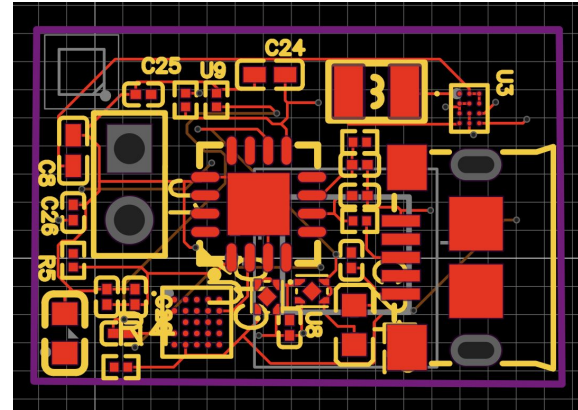
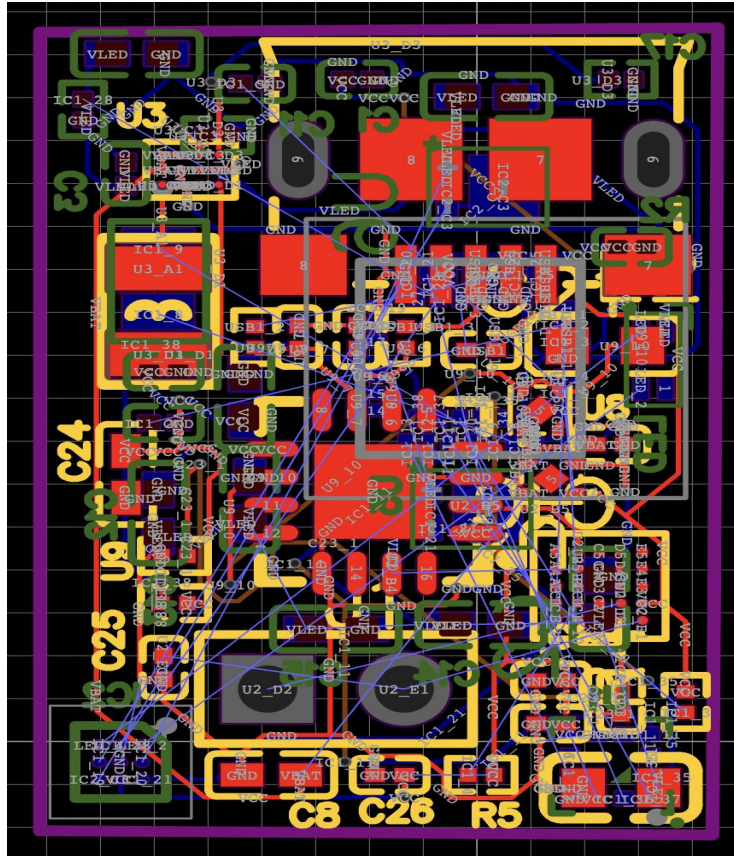




# Prototype Mk.2



# Prototype Mk.2 PCB





# Low Noise PCB Design Considerations

## Intelligent use of reference planes

- Placing reference planes adjacent to signal planes provides a low impedance path to ground

## Signal trace size and length

- Reducing impedance of signal traces protects sensitive analog signals

L1		Top Layer
L2		GND1
L3		Signal
L4		Power
L5		GND2
L6		Bottom Layer



# What's Next?

We plan to register for I2P in the coming fall semester to further these next steps for our device!

- Test overdose-detecting sensor accuracy against reference “gold standard” measurements
- Integrate our sensor with an elastic armband
- Add speaker + EMS pinging capabilities
- Create a pneumatic auto injecting needle housing
- Create a final design that is battery powered, smaller, and utilizes flexible PCB
- Discuss our design with harm reduction groups + other related parties

# Thank You

- Thank you to all the faculty that have gotten involved with our project as well as a special shoutout for our mentor, Professor Tom Collins!
- Our team plans to continue on with a second semester of I2P as we get our prototype fully functioning and ready for testing!
- Thank you to the CREATE-X faculty and staff who are involved in making this program happen. We thank you for this opportunity we have to participate in a program such as this!

# Sources

- We have a LIVE DOCUMENT for our sources since they are always in need of updating! See the link below!

[CLICK HERE FOR SOURCES](#)