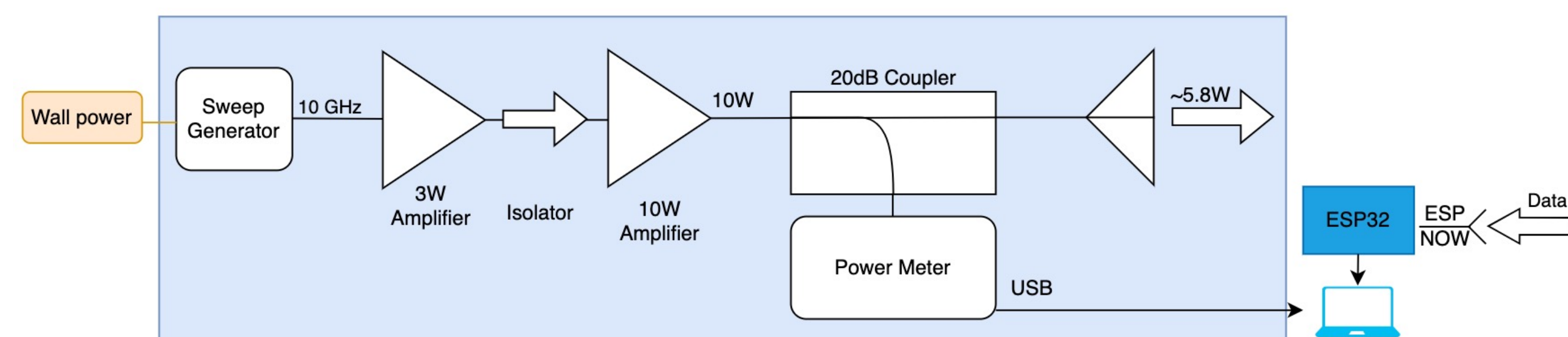


## OBJECTIVE

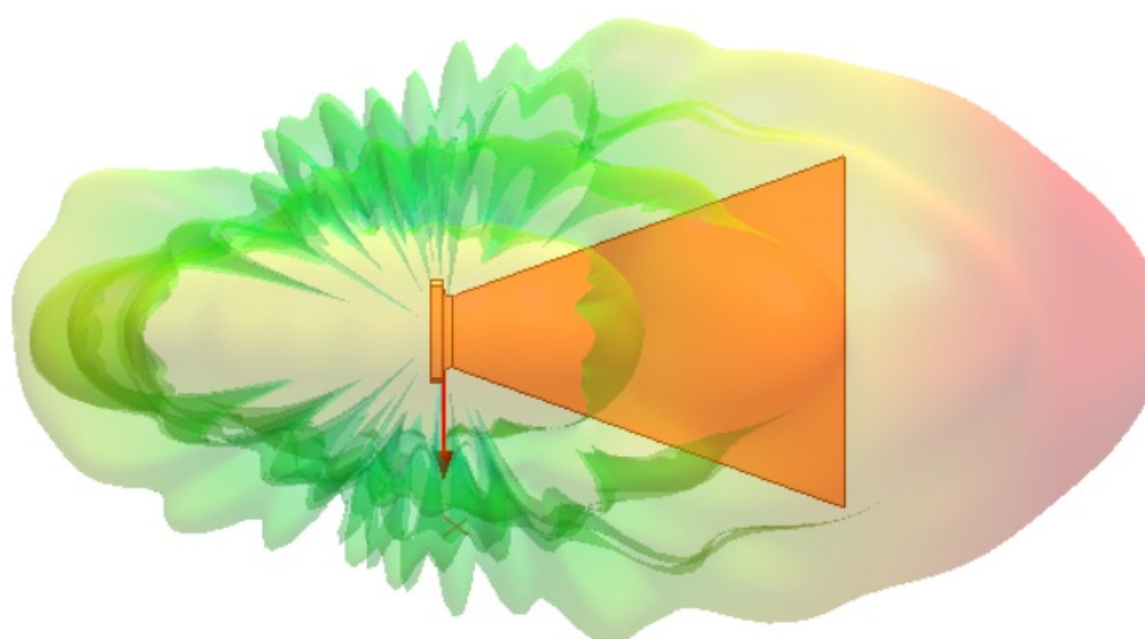
- Build and test a transmitting antenna with custom gain properties for a chosen beam height, frequency, and mat area.
- Design and manufacture a robust, flexible, lightweight receiving mat that rectifies incident RF to DC.
- Use DC from mat as input to a custom high efficiency maximum power delivery DC-DC converter that can charge a battery/power a load while extracting peak power from mat.

## TRANSMITTER



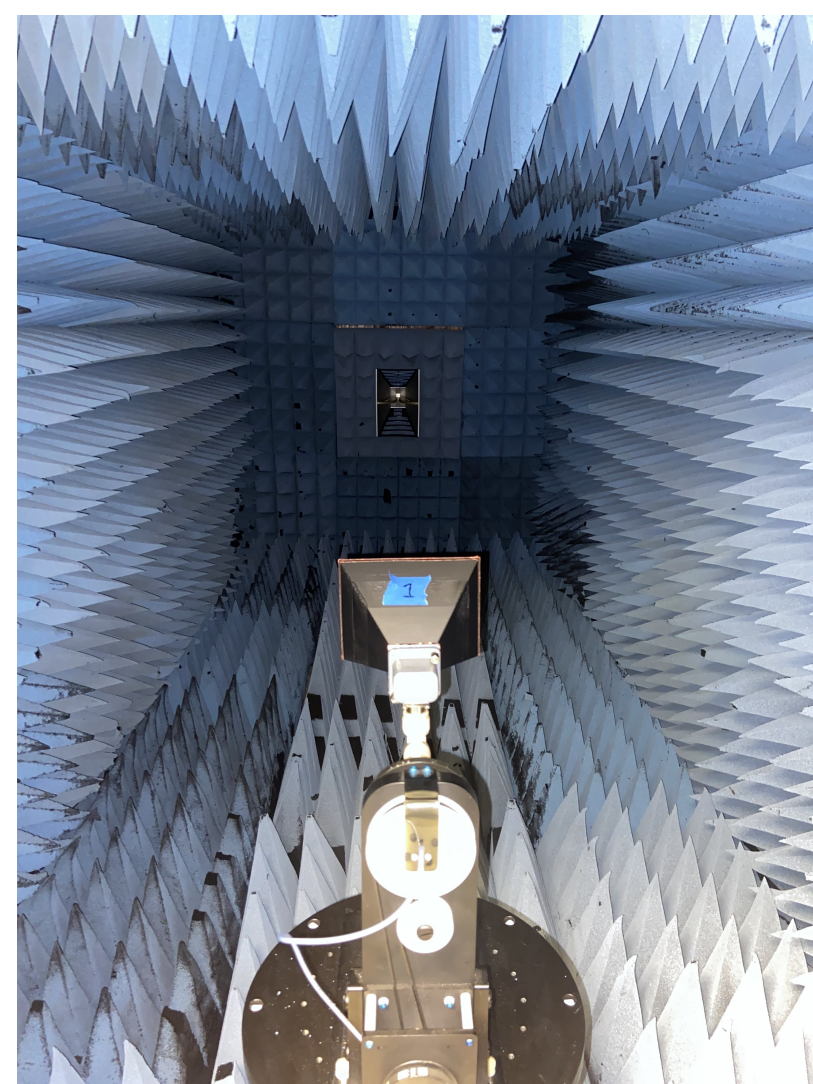
### Transmitting Chain:

- Generates signal at 10 GHz.
- Amplifies Power to 10W.
- Custom 3D-Printed Horn.
- Fast Prototyping.
- Directive Pattern.
- ~5.8 W is radiated.

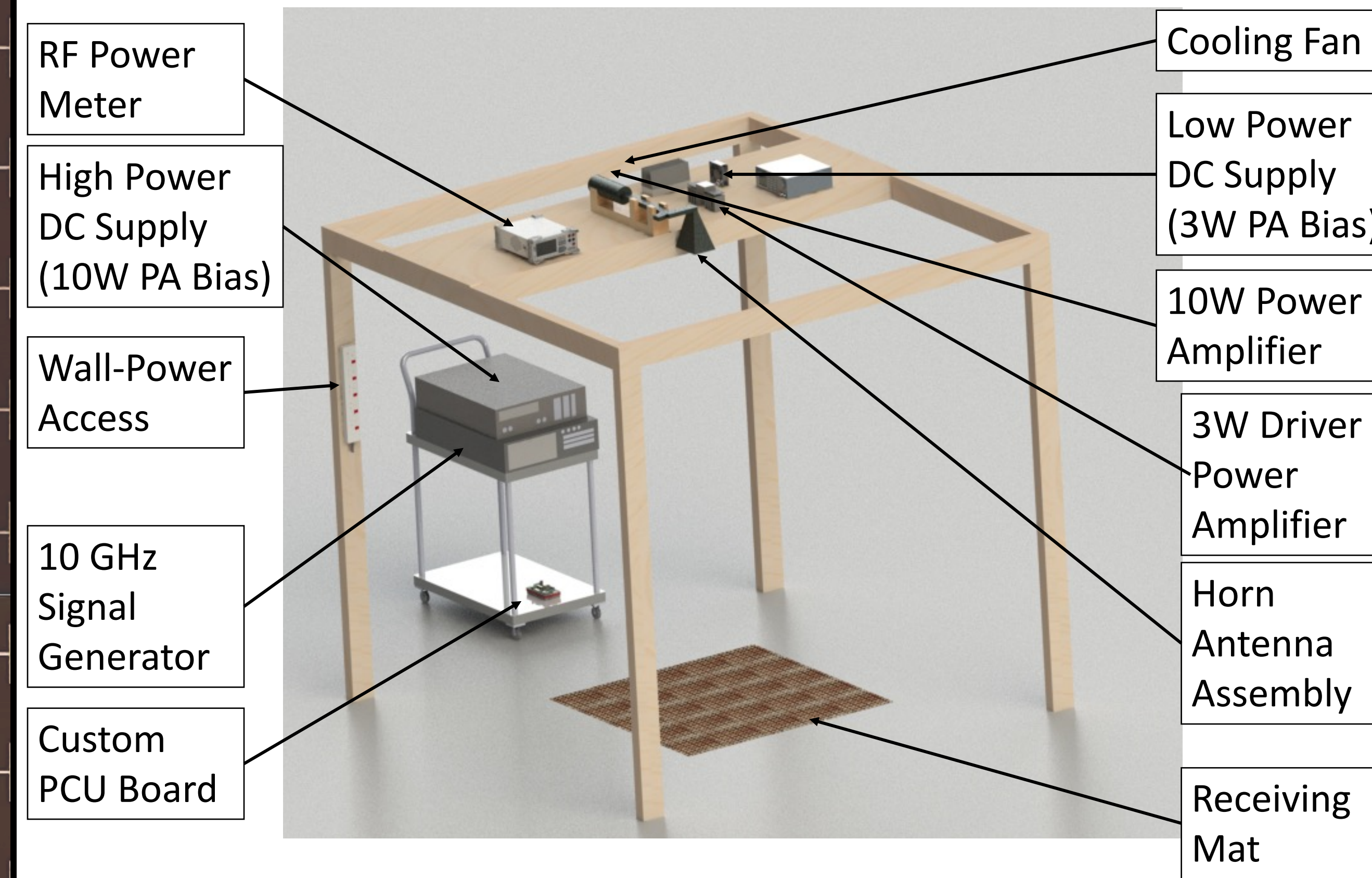


### Data:

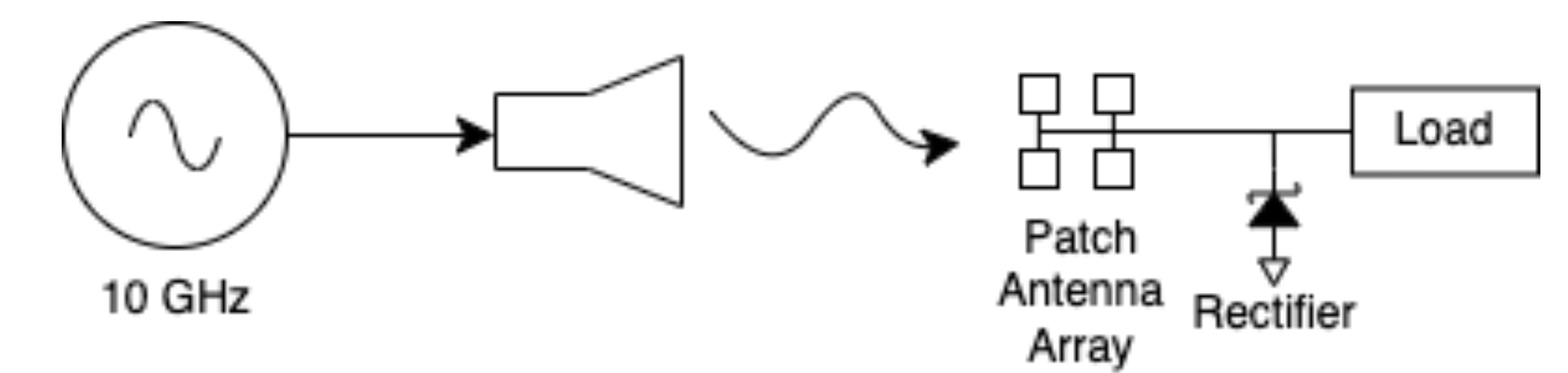
- Transmit power is sampled.
- Power measurement data collected from the receiver via ESP Now.
- Differential measurements at several points in receiver chain.
- Efficiencies calculated and displayed.



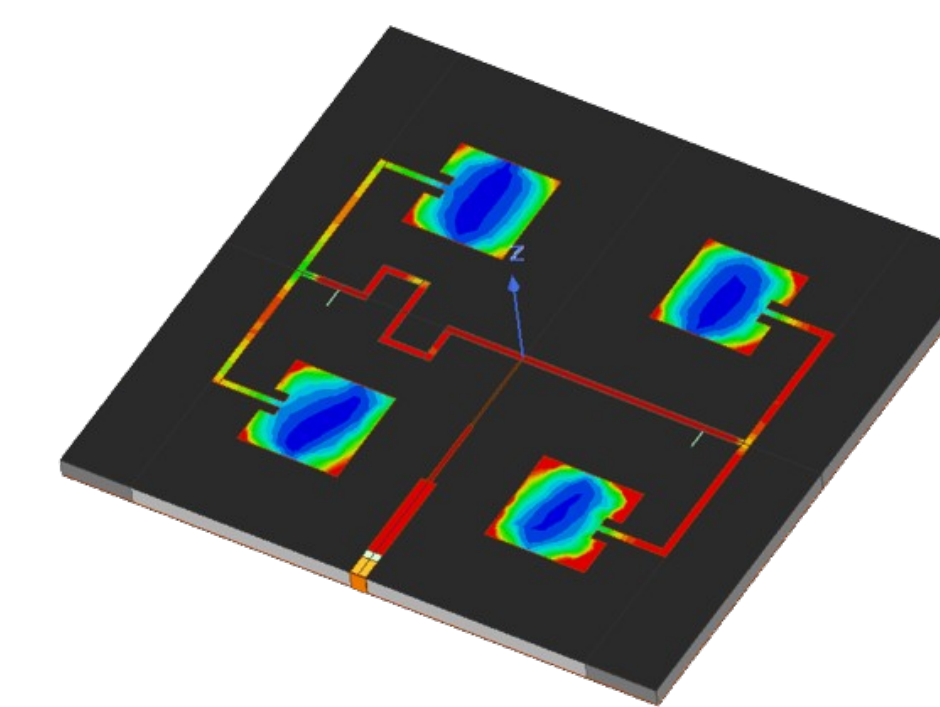
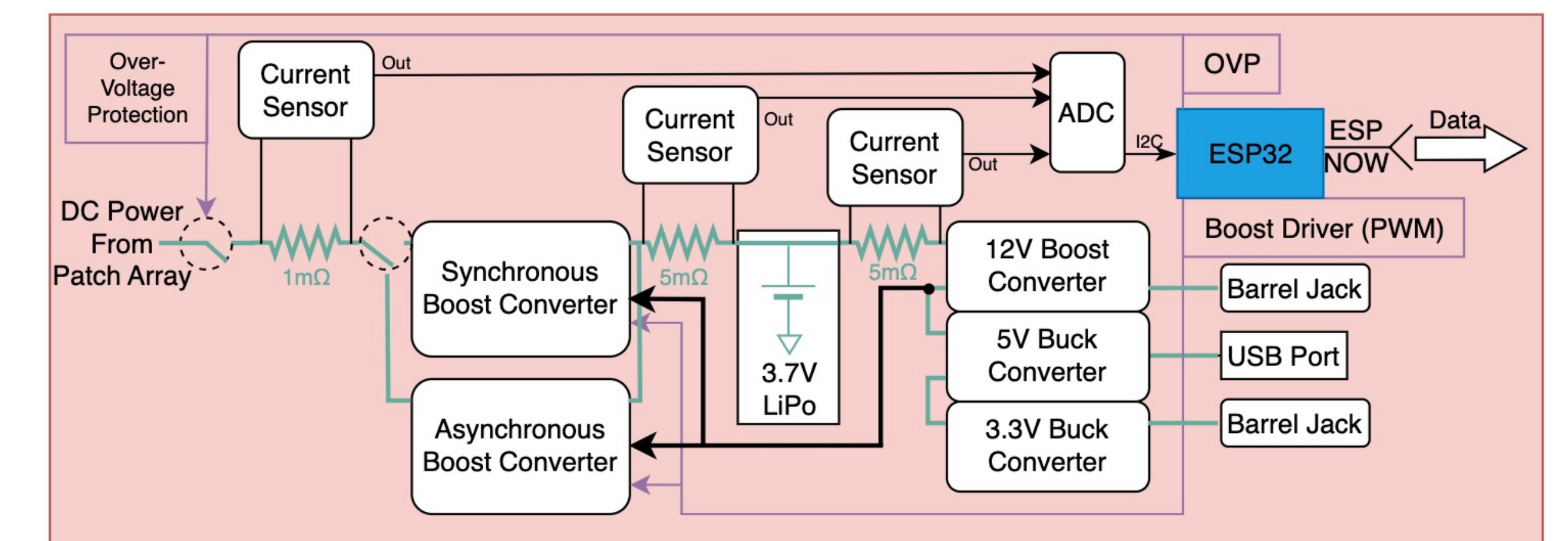
## TESTING SETUP



## THEORY



## RECEIVER



### Maximum Power-point Tracking:

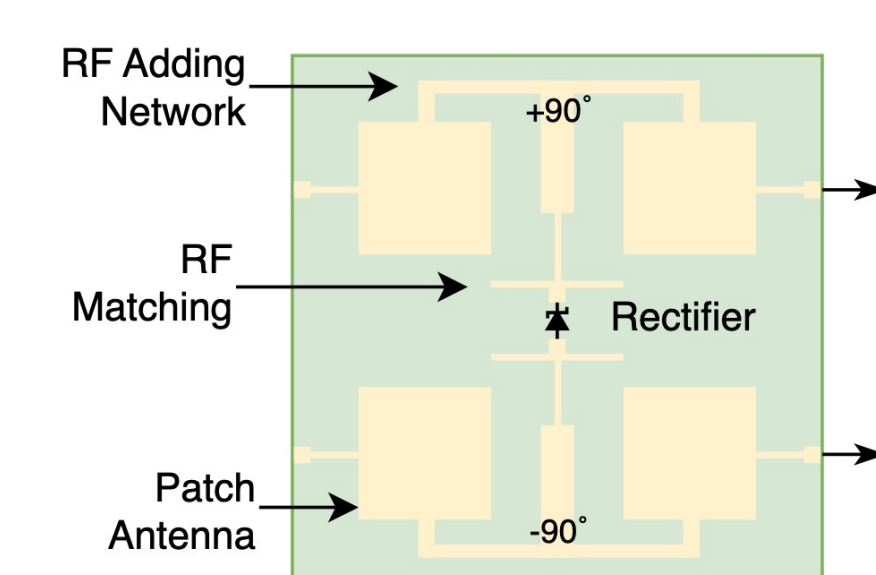
- Switching between open-loop sync. and async. boost converters

### Auxiliary Converters:

- 3.7V lithium-ion battery
- Provides stable load to source
- Provides stable power to board
- Current sink if supply exceeds demand
- Outputs for 12V, 5V, and 3V

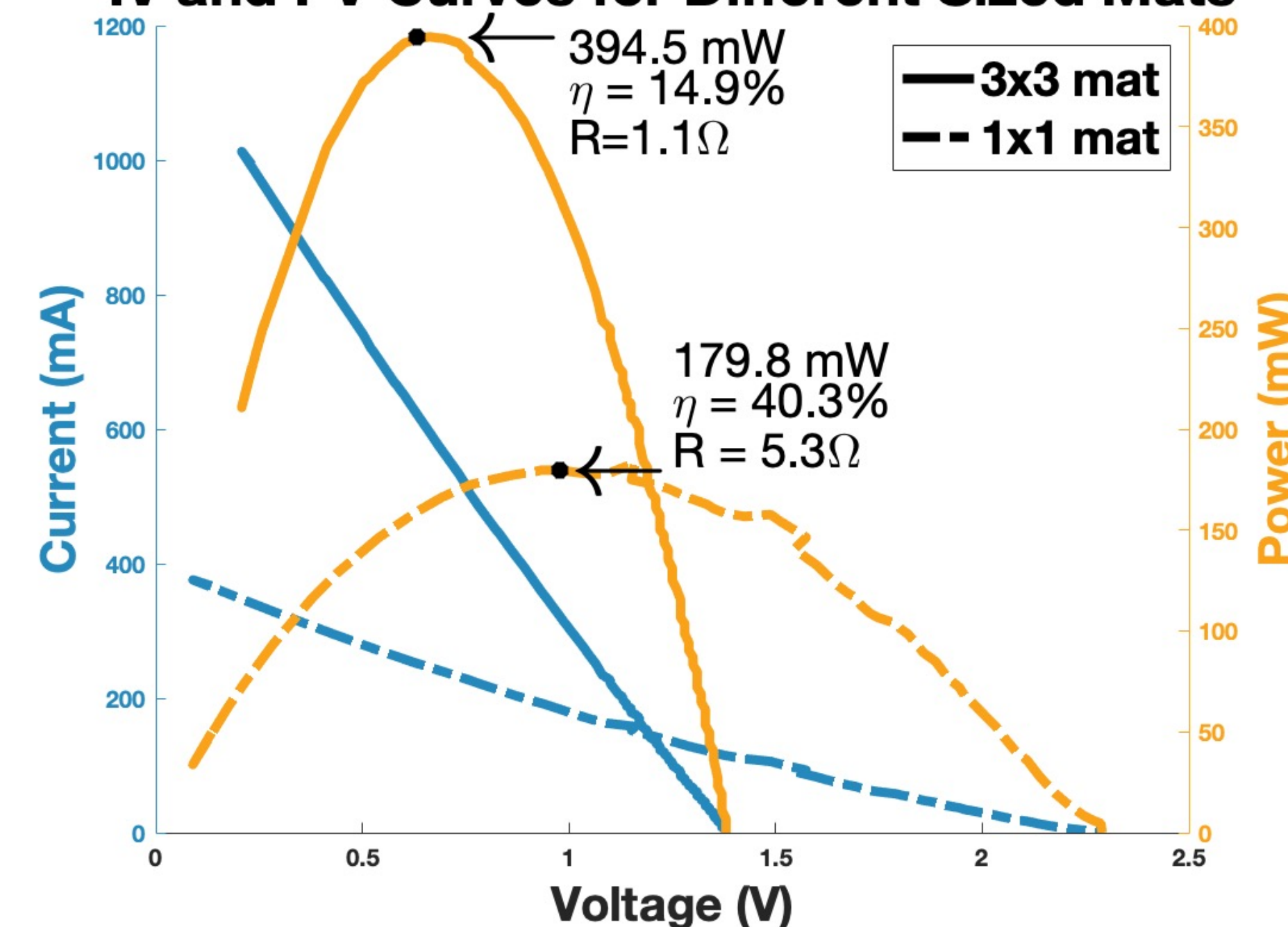
### Data:

- Power measured and reported to the transmitter
- Power from array
- Power sent to battery
- Power sent to load

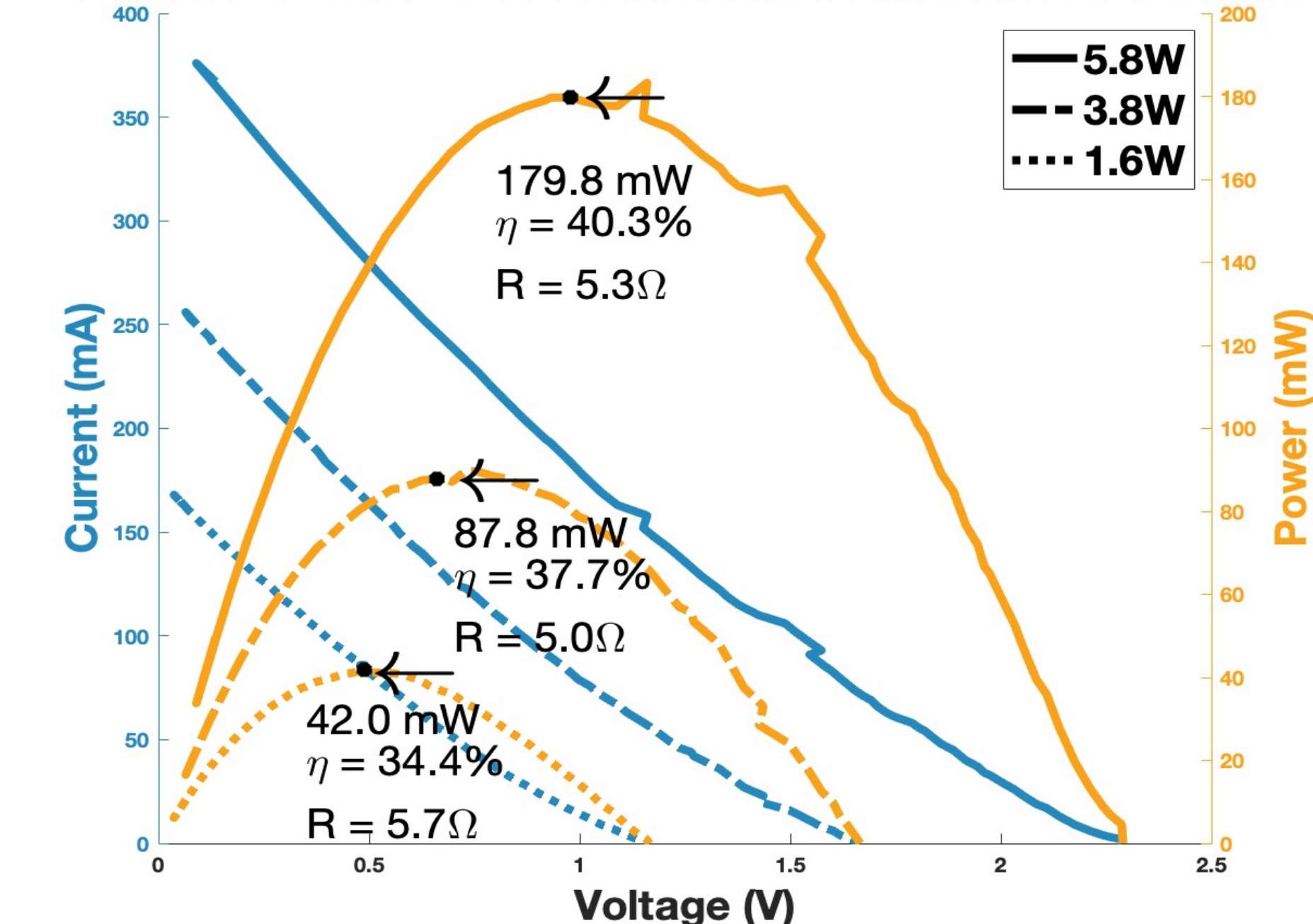


## RESULTS

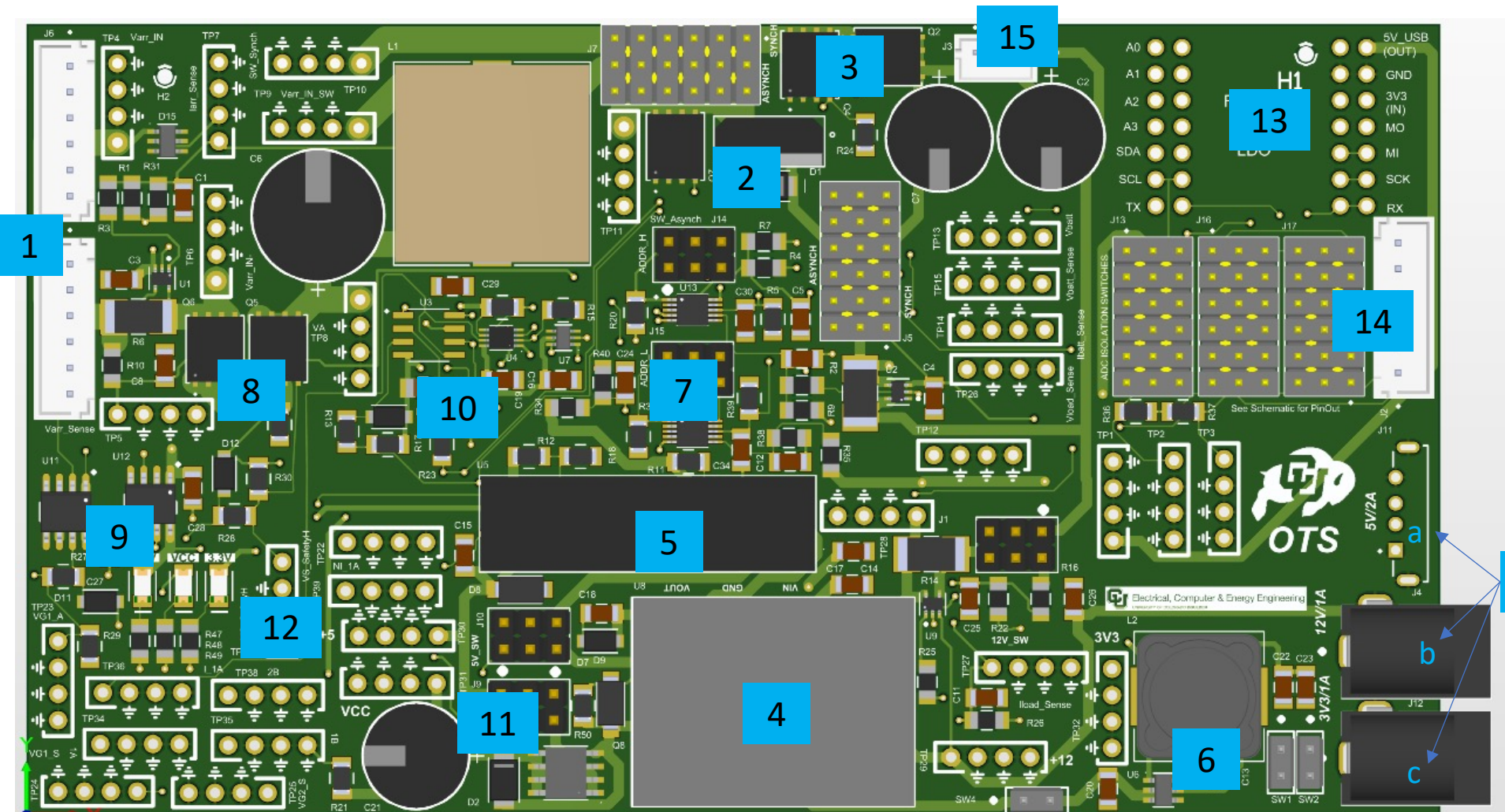
### IV and PV Curves for Different Sized Mats



### IV and PV Curves for Different Transmitted Powers



## POWER MANAGEMENT



4-Layer Board, 2oz-1oz-1oz-2oz copper

- Input Power Connectors
- Async. MPPT Boost Converter
- Sync. MPPT Boost Converter
- 12V, 24W Boost Converter
- 5V, 15W Buck Converter
- 3V3, 6W Buck Converter
- 2x 4-Channel 16-bit ADCs
- Over-voltage protection switch
- Async./OVP-FET 12V Gate Drivers
- Sync. 12V Bootstrap Gate Driver
- VCC PMOS-OR Logic
- Indication LEDs
- Mount for ESP32-S3
- Connector to Mat Sensors
- Battery Connector
- Output Power Connectors
  - 5V/2A USB-A
  - 12V/1A Barrel Jack
  - 3V3/1A Barrel Jack

## FUTURE CONSIDERATIONS

### Transmitter

- Scaling
  - Higher power
  - Larger distances
- Delivery
  - Battery storage
  - Aerial vehicle
- Utility
  - Higher fidelity measurements
  - Lower loss components

### Receiver

- Scaling
  - More arrays
- Longevity
  - Superstrate to protect diodes
  - Charge dissipation to prevent ESD
- Utility
  - Flexible adhesives
  - Lighter dielectric

### Power

- Utility
  - Smaller
  - More robust
- Better integration with microcontroller
- Integration with mat