

# Electromagnetic Soil Moisture Sensor (ESMS) Comprehensive Design Review (CDR)

Senior Design Project Team 21

March 7, 2017

# Meet the Team



**Academic Advisor:  
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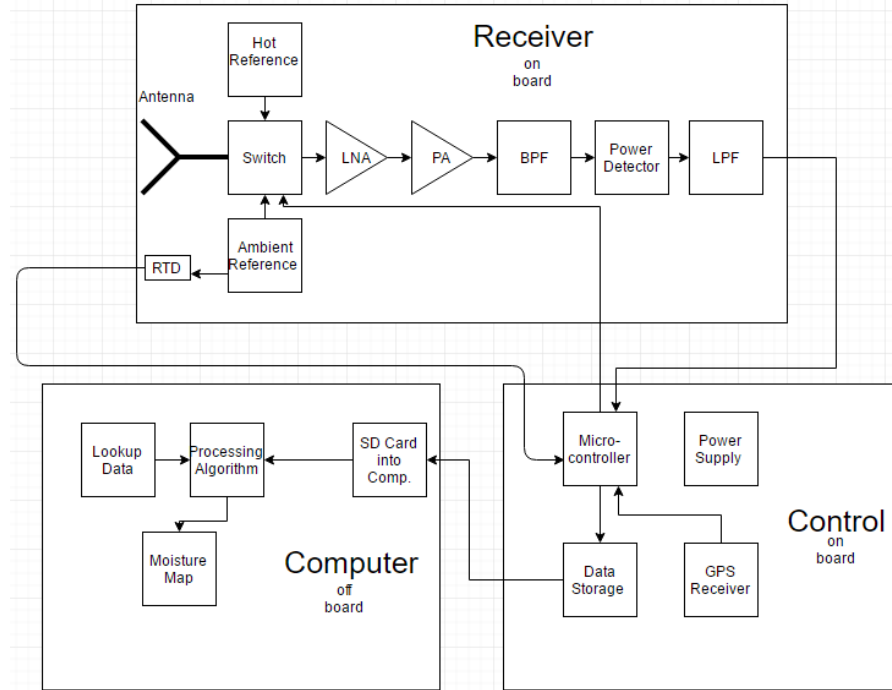


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EE**



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# Overview of the System (Block diagram)



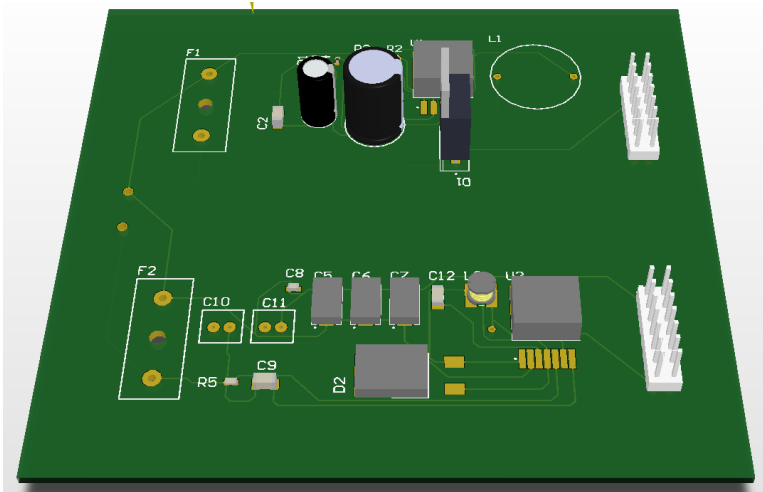
# CDR Deliverables

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- Power Board Design
- Reference sources functioning
- Data Processing
- GPS Location

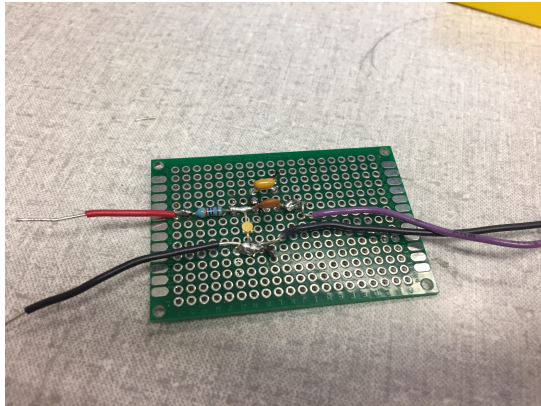
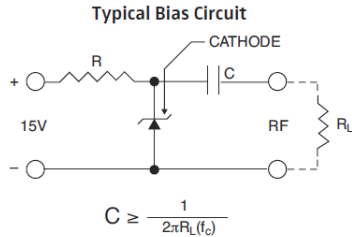


# Power Board Design



- 11.1V source
- Provides 15V (LT1171) and 5V (LM2679) supplies for the receiver elements and Arduino.
- 2 Layer PCB

# Reference Sources



- Ambient source: Matched Load
  - TMP36 temperature sensor Provides ambient temperature
- “Hot” Source: NoiseComm NC302
  - Measured ENR to be 18.55 dB
  - Appears 71.6x hotter than ambient

# Data Processing

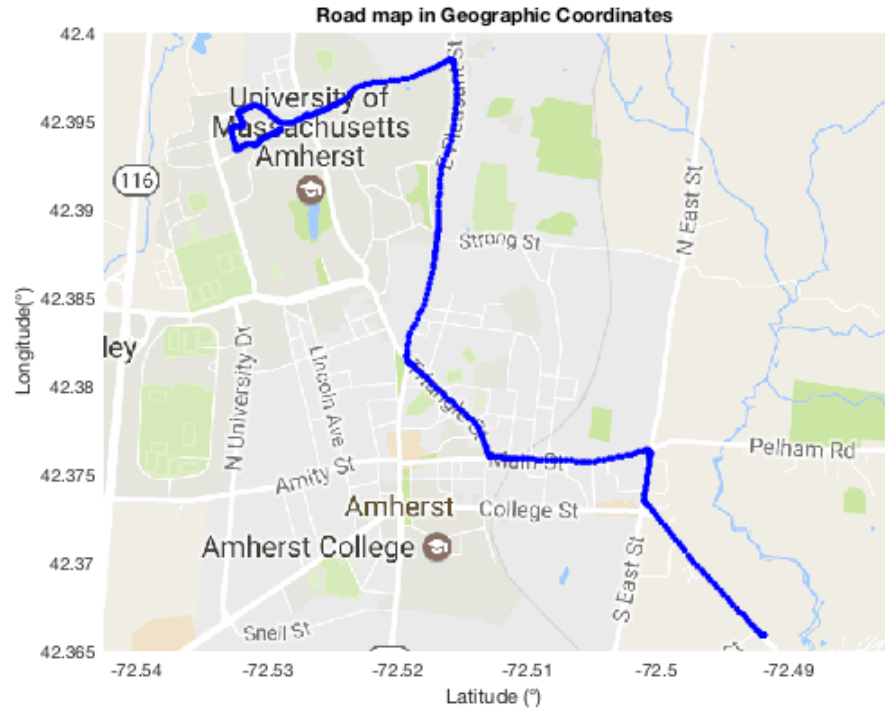
- SD card stores all receiver data for future processing

```
File Edit Format View Help
Antenna Data "Hot" Source Data Ambient Source Data Longitude Latitude Temperature of Ambient
```

- MATLAB: Linear interpolation to find antenna temperature

# GPS Data

- GPS data sampled at 10 Hz and data was processed and plotted on MATLAB
- Coordinates printed out every 2 seconds.



# Receiver Circuit

- Low Noise Amplifier
  - JCA12-3155
    - Gain = 36 dB
    - Noise Figure = 2.249 dB
- Power Amplifier
  - ZFL-2500-1
    - Gain = 28.1 dB
    - Noise Figure = 8.12 dB

$$F = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 * G_2}$$

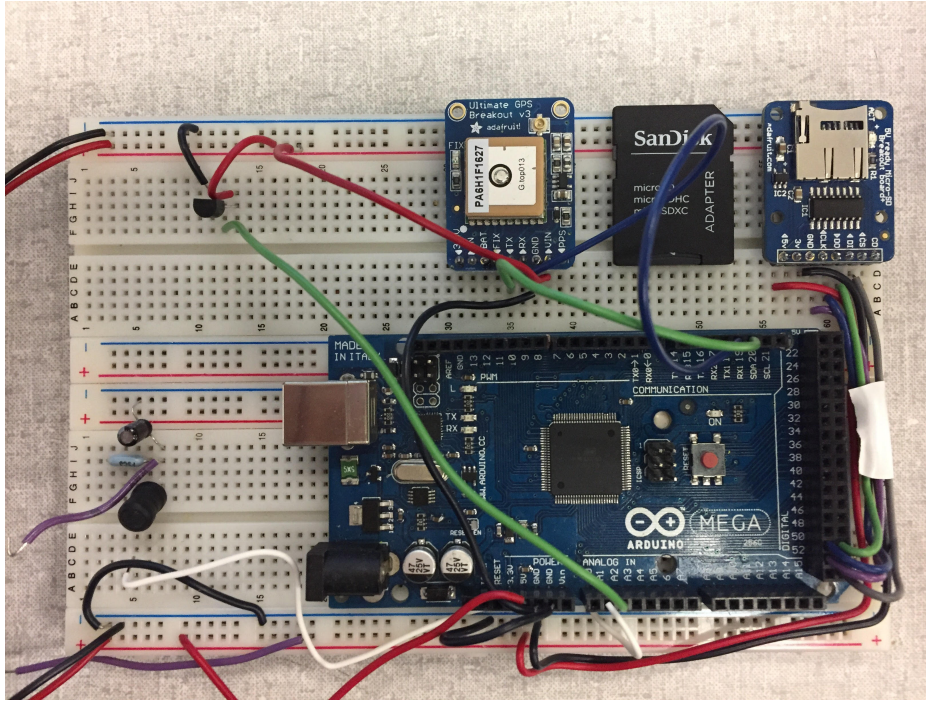
LNA, PA, LPF Cascade have a total noise figure of 2.253 dB

# Power Combiner



- ZC4PD-18-S+ 4 way power combiner
- Adds power from each antenna patch in phase
- $\sim 0.4$  dB insertion loss

# Arduino and Onboard Control



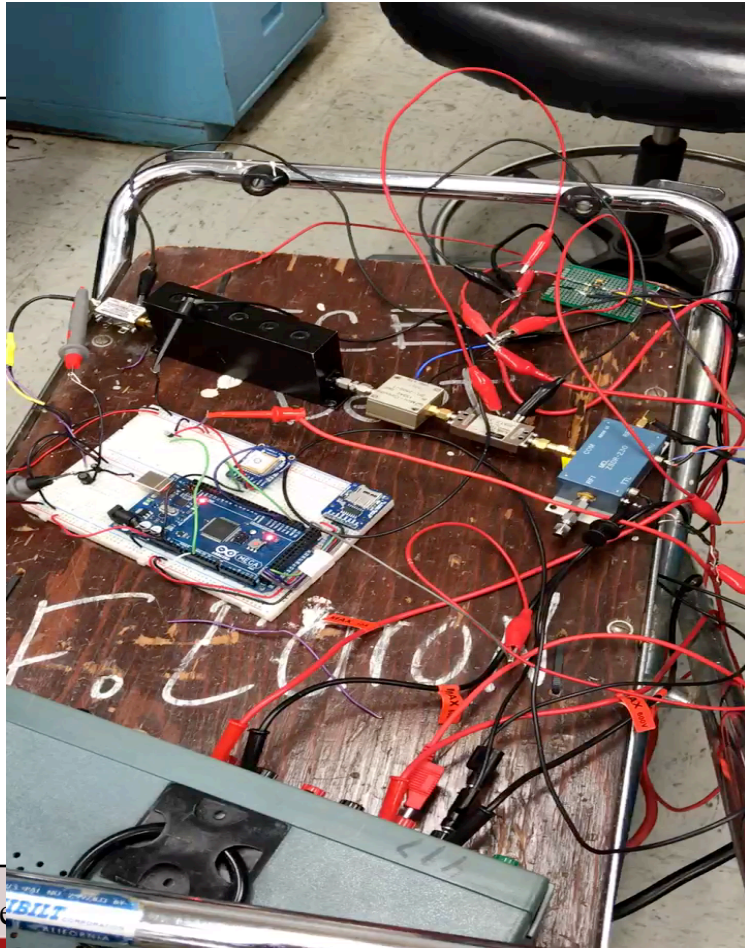
- GPS added
- Arduino controls the switch and all Data being received for later use.

# FPR Deliverables

- Antenna pattern
- User interface
- Test cases
- Demonstrable product
- Soil moisture map



# Demo





# Questions, Comments, Suggestions?

