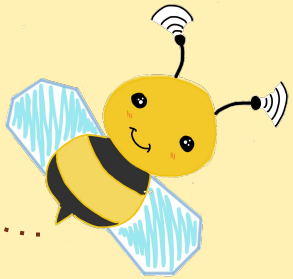
Critical Design Review

Team Bumblebee
Spring 2021



Members

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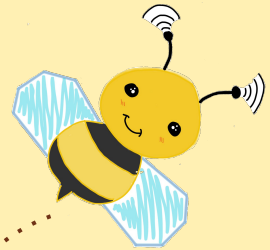
EE496, EE- EP

Thant Thiri
EE396, EE- EP

Lauryn Corpuz
EE496, EE-EP

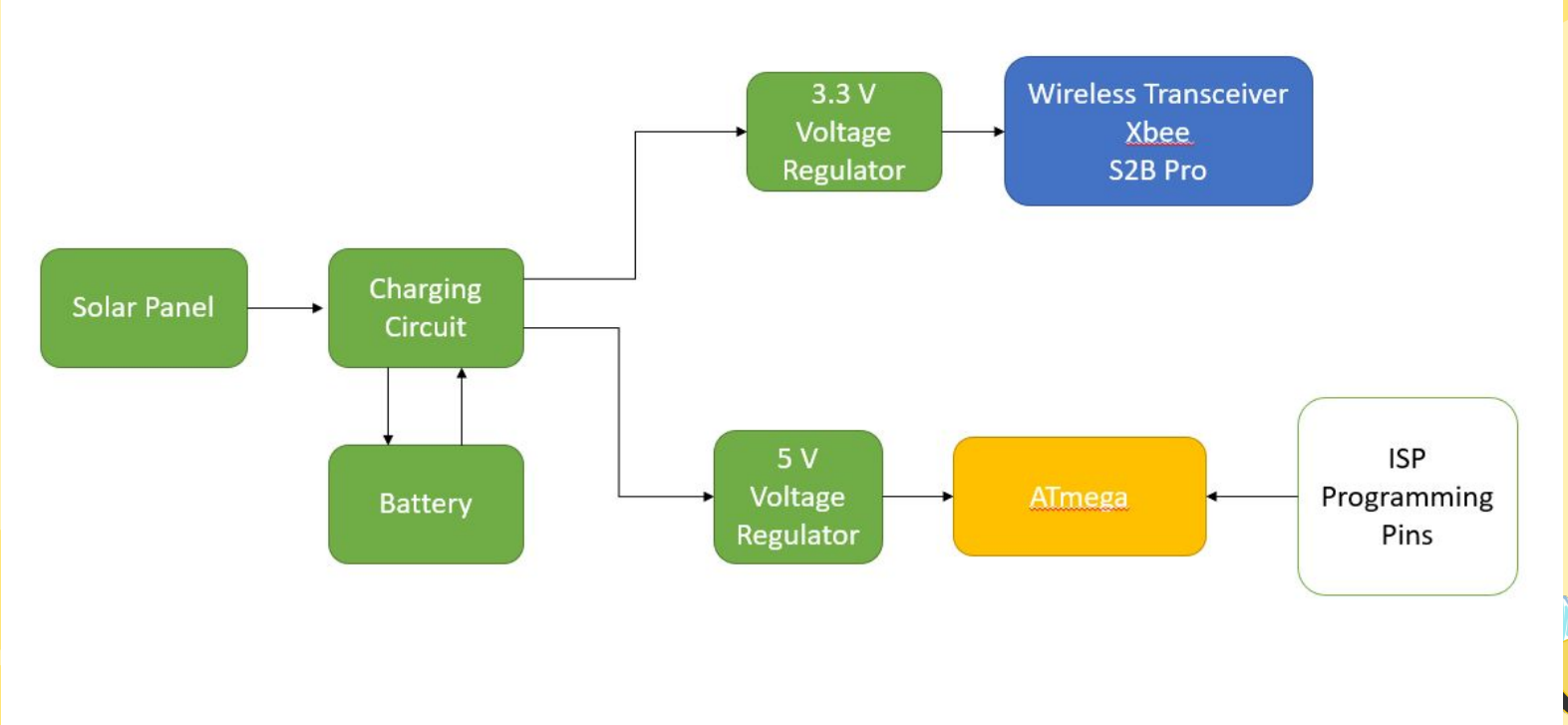
Yin Aye
EE396, EE-EP



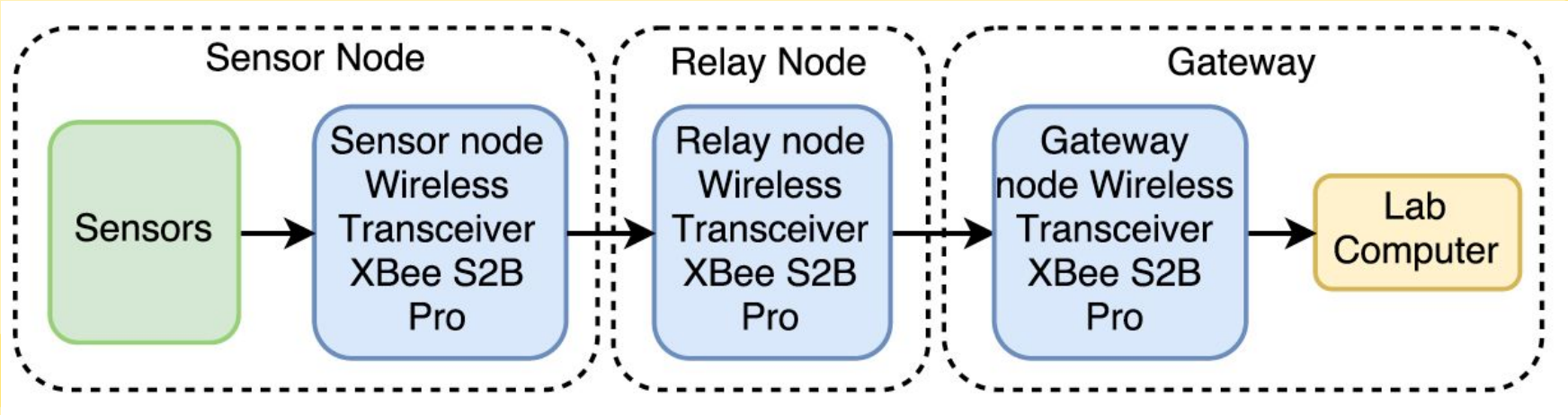
Presentation Overview

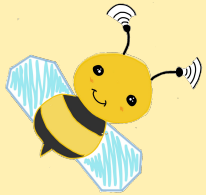
- Block Diagrams
  - Power
  - Signal/Communication
- Team Progress
- Problems
- Gantt Chart
- Upcoming Tasks
- Questions

Block Diagram- Power



Block Diagram- Signal/ Communication





Team Progress

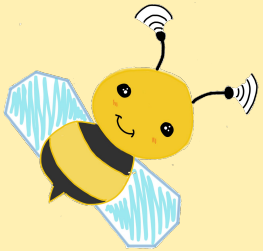
- Debugged v4.0 and v4.1
- Bootload and program v4.0 and v4.1
- Range tested with v4.0
- Started researching on many-to-one networking
    - Successfully transmitted ASCII values to nodes out of direct range with Bumblebee 4.0 as a relay router using DigiMesh.

Version 4.0

Version 4.1

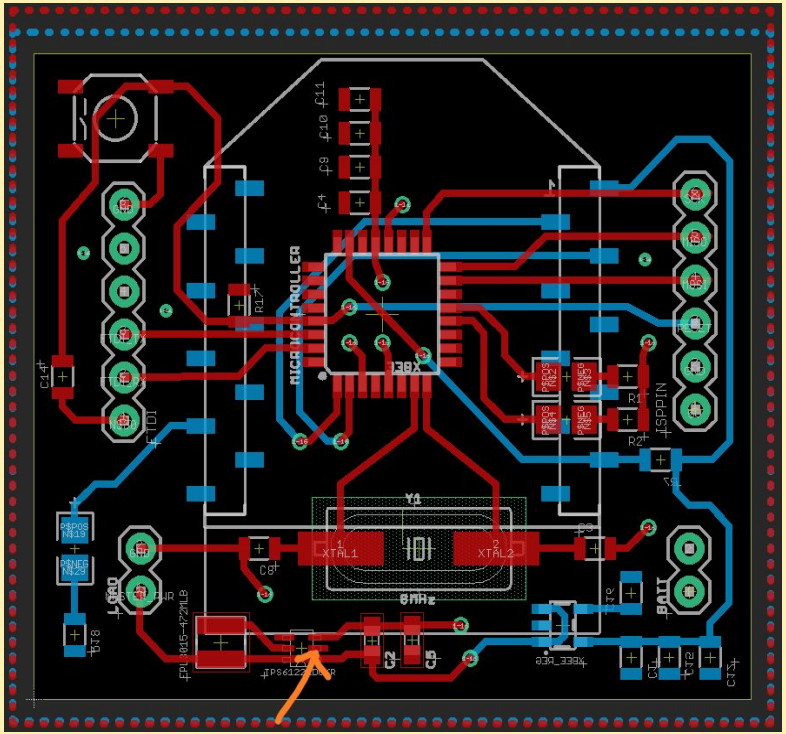
V4.0 Range Test

https://docs.google.com/spreadsheets/d/1_eK2p0x19abkHIDw29yHxFrI76881LTB/edit#gid=1237470660



Problems

- Trouble with bootloading Bare Bumblebee
  - Received help from Team Guava
  - Switched capacitor in reset to a resistor on breadboard.
- V4.0 and 4.1
  - RX and TX are switched between bootloading methods of Arduino and FTDI.
- V4.1
  - Version 4.1 did not have feedback connected to V_out on the Boost converter. Functionality was achieved with a small jumper but this added stray capacitance.
    - Without FB boost converter output was dropping battery 3.7 V_in to 0.4 V_out. This is why 4.1 would not establish communication/ boot load/ upload sketch.



7 Pin Configuration and Functions

DCK PACKAGE
(TOP VIEW)

Pin Functions

PIN NAME	PIN NO.	I/O	DESCRIPTION
EN	6	I	Enable input (1: enabled, 0: disabled). Must be actively tied high or low. Do not leave floating.
FB	2	I	Voltage feedback of adjustable version. Must be connected to V_{OUT} at fixed output voltage versions.
GND	3		Control / logic and power ground

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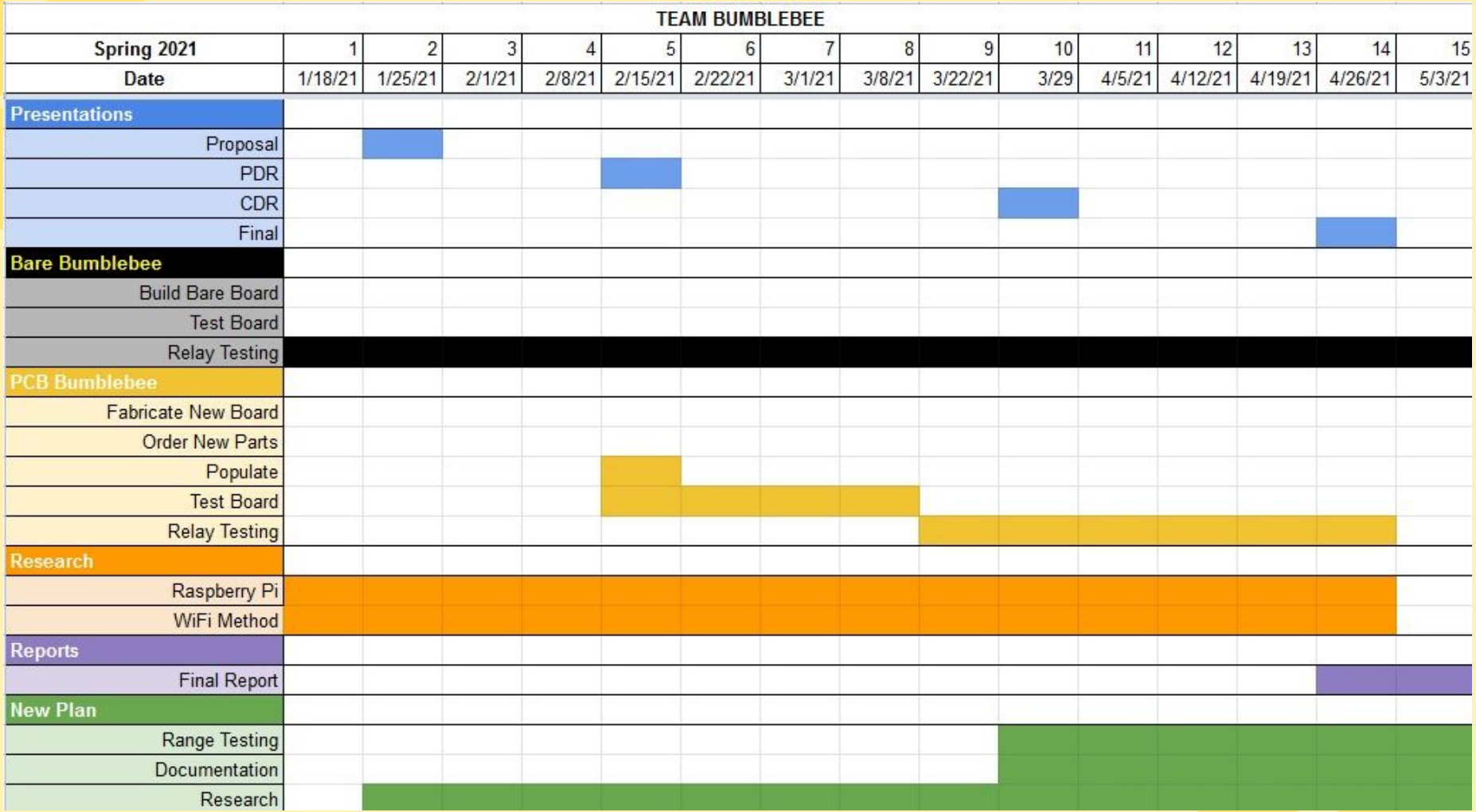
TEAM BUMBLEBEE
Spring 2021
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Date
1/18/21
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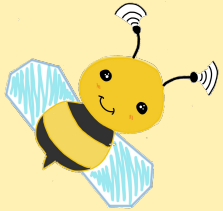
3/29
4/5/21
4/12/21
4/19/21
4/26/21
5/3/21
Presentations
Proposal
PDR
CDR
Final
Bare Bumblebee
Build Bare Board
Test Board
Relay Testing
PCB Bumblebee
Fabricate New Board
Order New Parts
Populate
Test Board
Relay Testing
Research
Raspberry Pi
WiFi Method
Reports
Final Report
New Plan
Range Testing
Documentation
Research



Upcoming Tasks

- Research many-to-one network
- Compile Range Testing Results
- Continue to document our work and results
- Implement changes needed to V4.1 to design V4.2.

Upcoming Tasks on version 4.2 design

- V4.2
  - Implement decoupling capacitors in Xbee voltage supply per manufacturer recommendations.

Power supply design

A poor power supply can lead to poor device performance, especially if you do not keep the supply voltage within tolerance or if it is excessively noisy. To help reduce noise, place a 1.0 µF and 8.2 pF capacitor as near as possible to the VCC connection on the XBee 3 (pad 2 for micro and surfacemount, and pin 1 for through-hole). Adding a 10 µF decoupling capacitor is also recommended. If you are using a switching regulator for the power supply, switch the frequencies above 500 kHz. Limit the power supply ripple to a maximum 50 mV peak to peak. For best results, place the lower capacitance capacitors closest to the XBee 3 device.

Note XBee 3 parts with an early revision of the microcontroller unit (MCU) may experience an issue recovering from brownouts under rare conditions. See Brownout issue for details on how to avoid this issue.

Board layout

We design XBee 3 modules to be self-sufficient and have minimal sensitivity to nearby processors, crystals or other printed circuit board (PCB) components. Keep power and ground traces thicker than signal traces and make sure that they are able to comfortably support the maximum current specifications. There are no other special PCB design considerations to integrate XBee 3 modules, with the exception of antennas.

Antenna performance

Antenna location is important for optimal performance. The following suggestions help you achieve optimal antenna performance. Point the antenna up vertically (upright). Antennas radiate and receive the best signal perpendicular to the direction they point, so a vertical antenna's omnidirectional radiation pattern is strongest across the horizon.

Position the antennas away from metal objects whenever possible. Metal objects between the transmitter and receiver can block the radiation path or reduce the transmission distance. Objects that are often overlooked include:

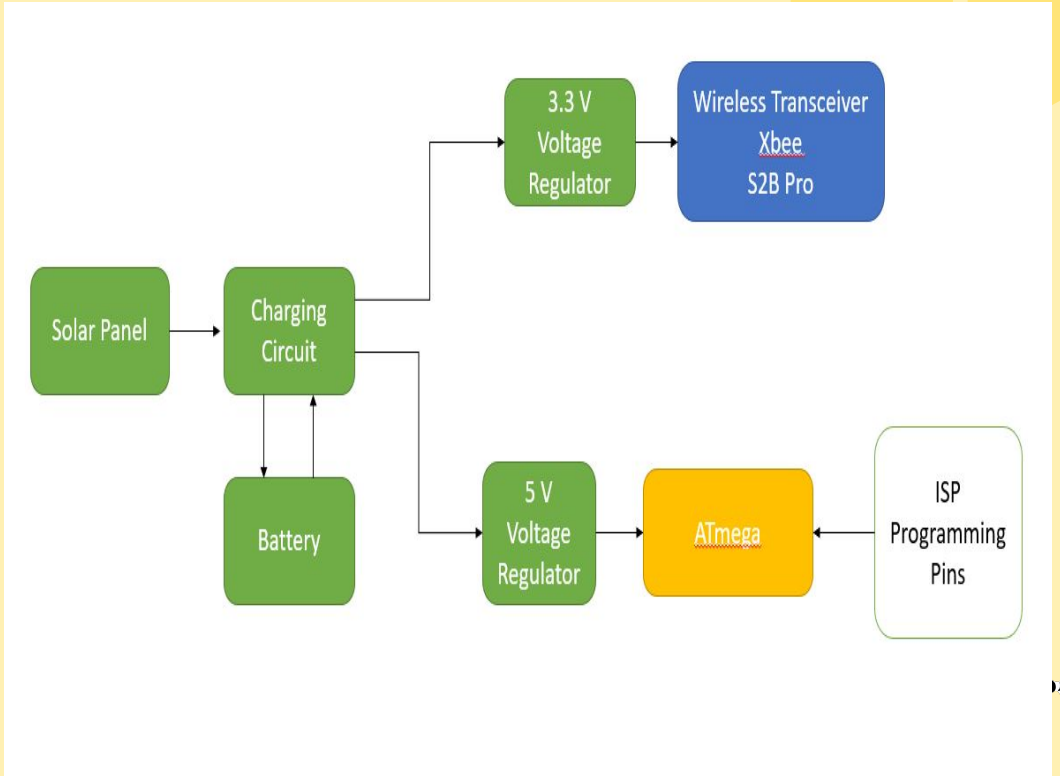
Upcoming Tasks on version 4.2 design

Operating voltage:

- 2.7V to 5.5V for ATmega328P • Temperature range:
- Automotive temperature range: –40°C to +125°C • Speed grade:
- 0 to 8MHz at 2.7 to 5.5V (automotive temperature range: –40°C to +125°C)
- 0 to 16MHz at 4.5 to 5.5V (automotive temperature range: –40°C to +125°C) • Low power consumption
- Active mode: 1.5mA at 3V - 4MHz
- Power-down mode: 1µA at 3V

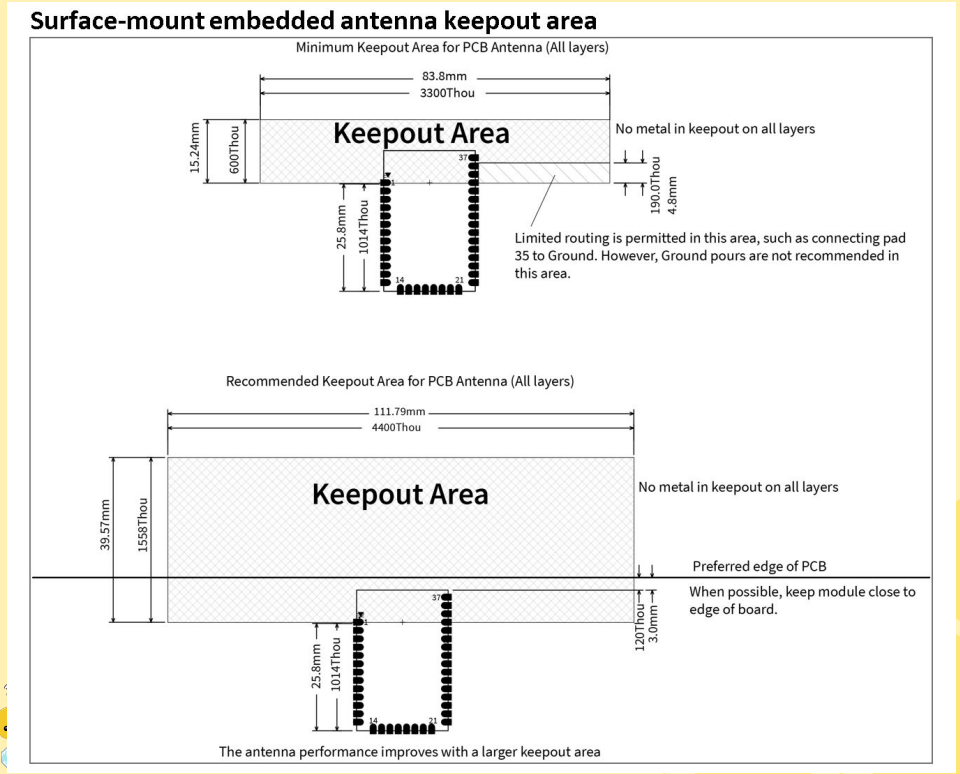
- Change voltage regulator.

  TBD new design.



Upcoming Tasks on version 4.2 design

- V4.2
  - Enlarge PCB in order to increase separation of XBee antenna.
  - Reduces interference by keeping PCB traces out of EM wave while antenna is transmitting.



Questions?