Drone Automated Mesh Network

| Dean Wedeking | Liam Rapoza | Michael Fox | Logan Jay Williams |
| Donovan Rowzee | Michael Bukowski | Matt Houser |

Advisors: ECE Chair Dr. Chunting Mi & Andy Bushnell of ARRS Technologies

SAN DIEGO STATE

ECE 496B
Spring 2020

Background

Drones have become increasingly capable and have become a crucial component in accomplishing many modern day tasks. To increase the effective range of drones and reduced the downtime, infrastructure should be in place to artificially extend drone range. The basis of this concept is wireless charging.

Overview

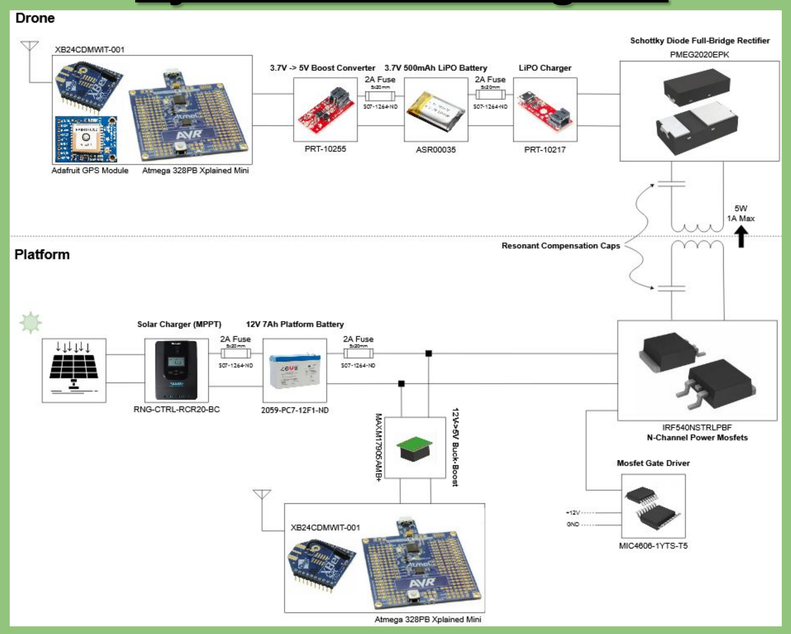
The wireless drone charging platform operates from the concept of wireless power transfer. This solution provides for more frequent use of the drone and eliminates the need for human intervention in the charging process.

Specifications

Key Features:
- Solar-Powered
- Wireless
- 12+ Charge Platform Capacity
- Potential for Automation

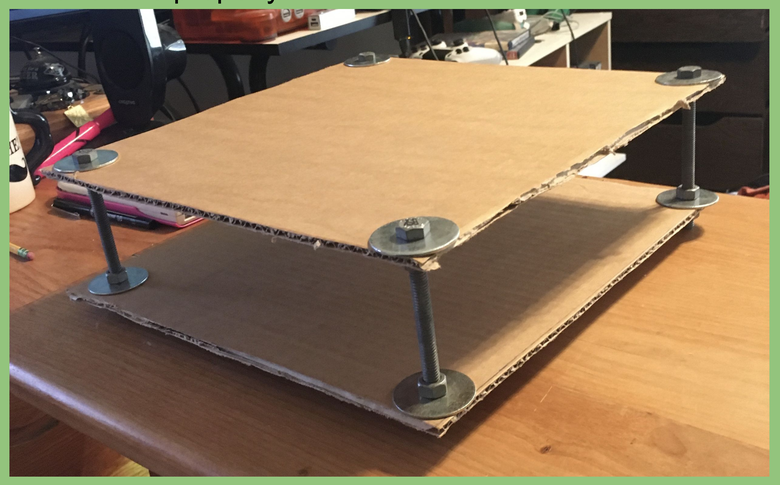
- 5W Delivered Wirelessly
- 4-7cm Charging Distance
- 120kHz Switching Frequency
- 22min Charging Time
- 7Ah Platform Battery
- 500mAh Drone Battery

System Block Diagram



System Descriptions

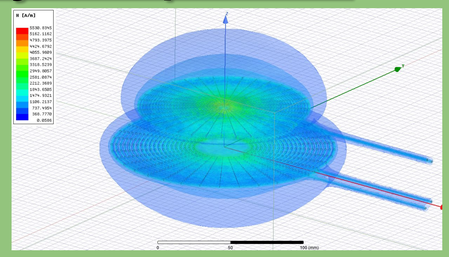
- Power Delivery
  - Ensures that the WPT and microcontrollers are supplied enough power from the solar panels to function.
- Power Management
  - Includes the rectifier and the inverter. Responsible for changing from AC to DC, and vice versa.
- Wireless Power Transfer
  - This subsystem contains the coils themselves and the physics of the transfer.
- Communications
  - Systems programmed to allow the drone to communicate with the platform via XBee and GPS.
- Control Systems
  - Subsystem dedicated to detecting when the battery is fully charged and ensuring that the whole system functions properly.

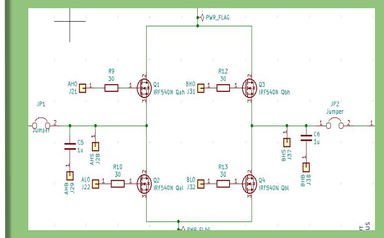


Mock Platform

Hardware / Key Components

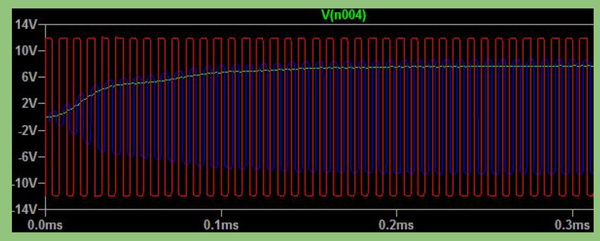
Single Coil Design
- SS compensation topology
- Coupling coeff. = 0.324
- 12.08µH Mutual Induct.

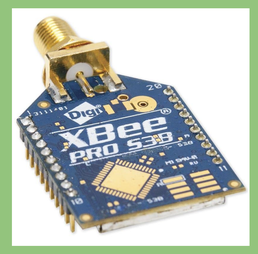




Full Bridge Inverter
- Operates at 120kHz
- 12VDC - 24Vpp AC
- IRF 540N FETS
- PWM driven, forced dead time

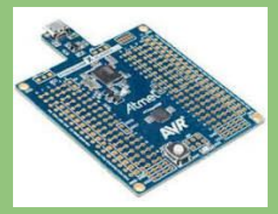
Full-Bridge Rectifier
- Schottky diodes with low 2 * 0.45V drop

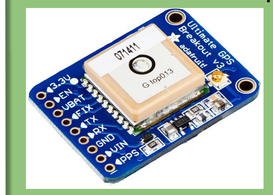




XBee Communication Module
- Radio communication link between drone and platform
- Lightweight, low power, low cost
- Interchangeable with other XBee Modules

XPlained Mini Dev Board
- Processor: ATMega 328PB
- Two USART Interfaces
- Analog-Digital Converters
- 5V Power Supply

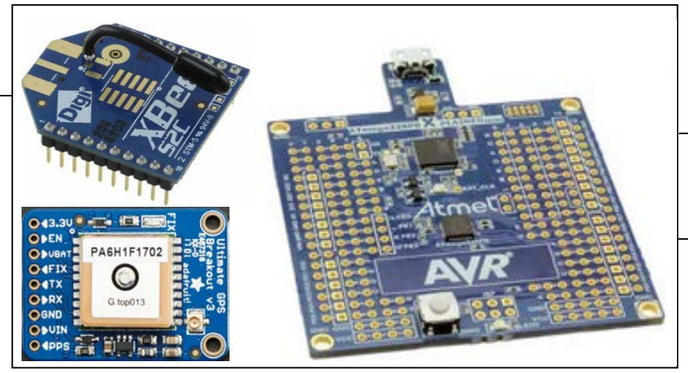




Adafruit Ultimate GPS
- 5V, 20mA
- Internal Antenna
- <3 meter accuracy

Drone

XB24CDMWIT-001



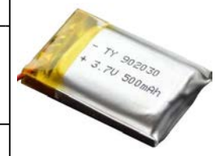
Adafruit GPS Module Atmega 328PB Xplained Mini

3.7V -> 5V Boost Converter

PRT-10255

2A Fuse
5x20mm
507-1264-ND

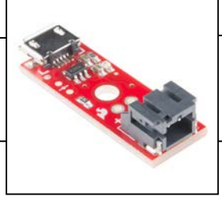
3.7V 500mAh LiPO Battery



ASR00035

2A Fuse
5x20mm
507-1264-ND

LiPO Charger



PRT-10217

Schottky Diode Full-Bridge Rectifier

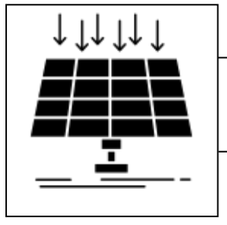
PMEG2020EPK

5W
1A Max

Resonant Compensation Caps

Platform

Solar Charger (MPPT)



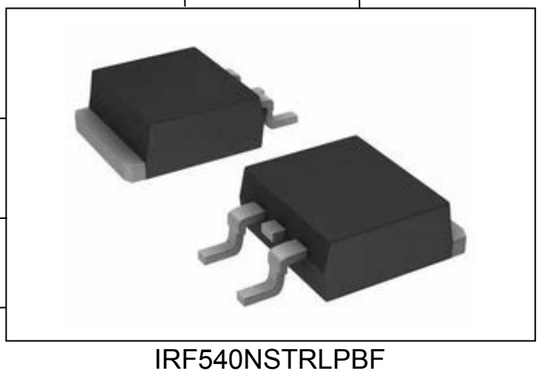
RNG-CTRL-RCR20-BC

2A Fuse
5x20mm
507-1264-ND

12V 7Ah Platform Battery

2059-PC7-12F1-ND

2A Fuse
5x20mm
507-1264-ND



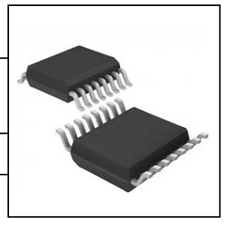
IRF540NSTRLPBF

N-Channel Power Mosfets

MAXM17905AMB+

12V->5V Buck-Boost

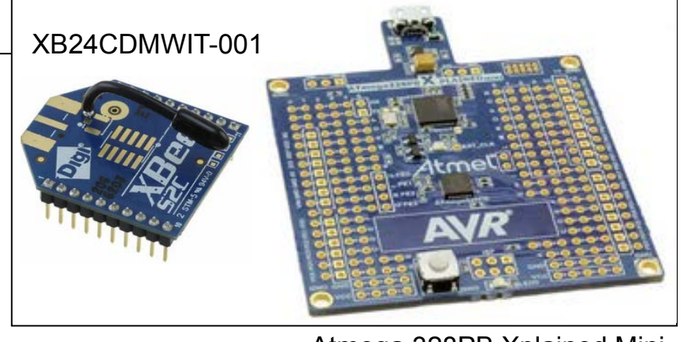
Mosfet Gate Driver



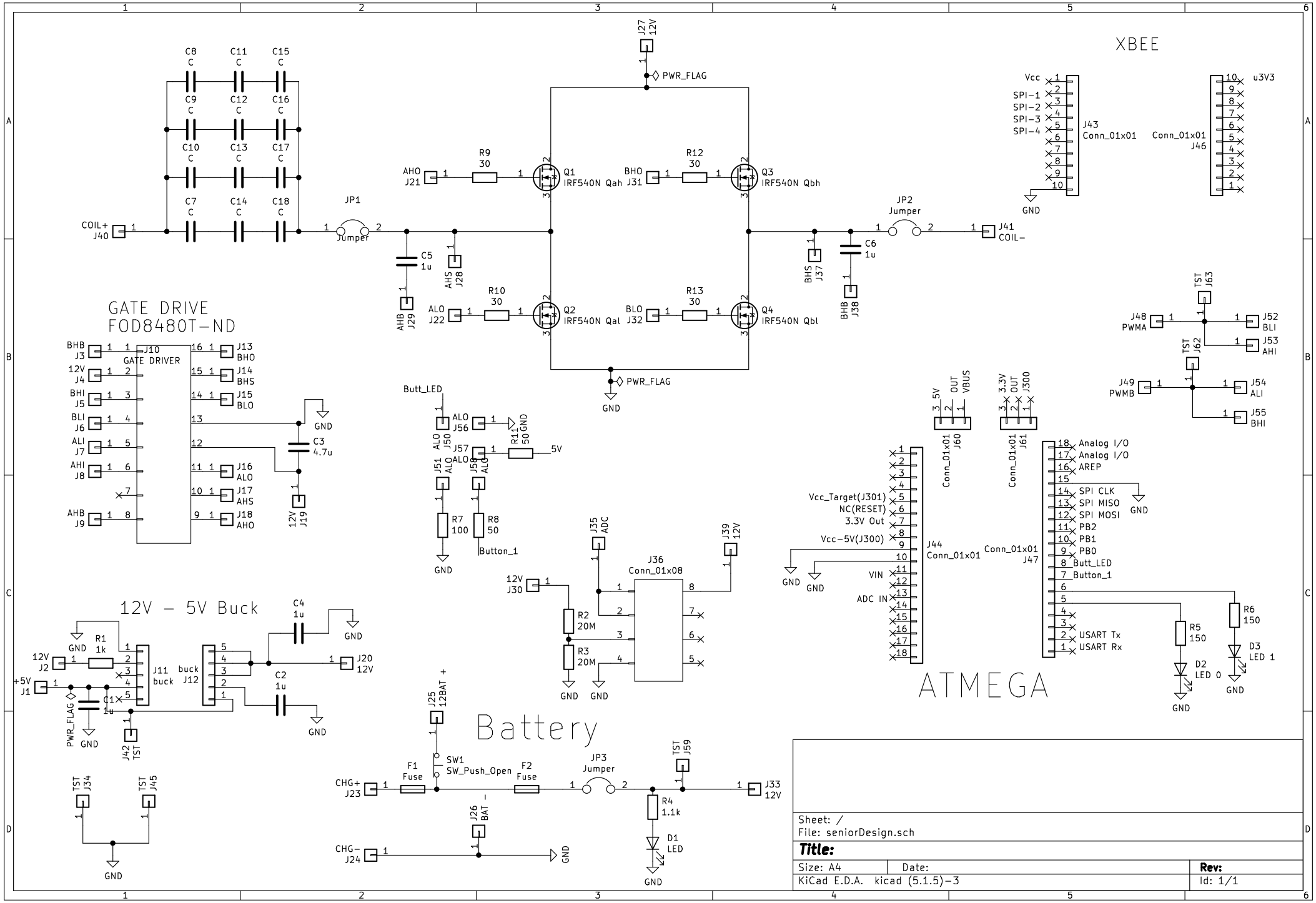
+12V
GND

MIC4606-1YTS-T5

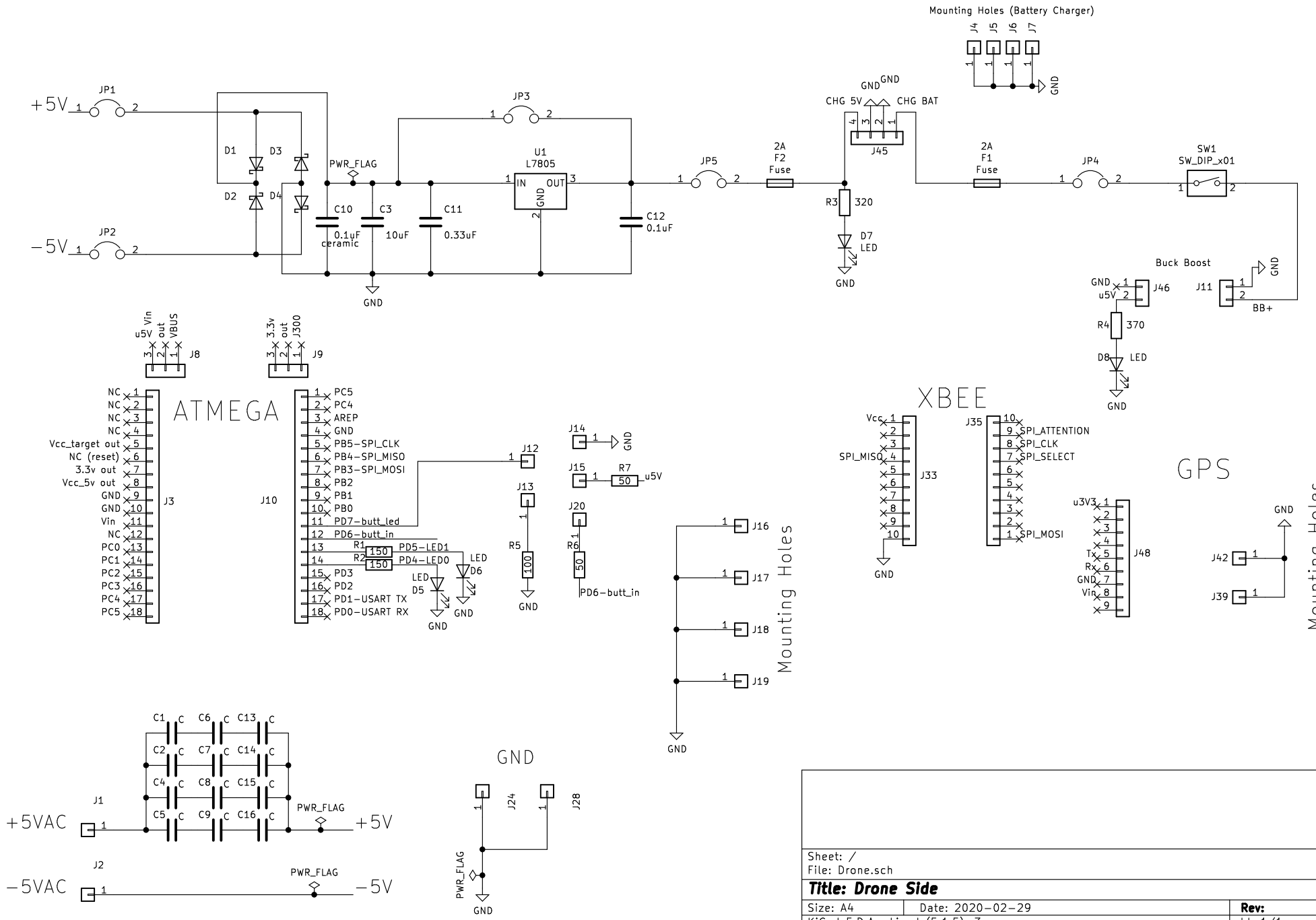
XB24CDMWIT-001



Atmega 328PB Xplained Mini



Sheet: /		
File: seniorDesign.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.5)-3		Id: 1/1


Mounting Holes (Battery Charger)
J4
J5
J6
J7
GND
+5V
JP1
D1
D3
D2
D4
PWR_FLAG
JP3
U1
L7805
IN
OUT
GND
C10
0.1uF
ceramic
C3
10uF
C11
0.33uF
C12
0.1uF
JP2
−5V
JP5
2A
F2
Fuse
GND
CHG 5V
CHG BAT
J45
R3
320
D7
LED
2A
F1
Fuse
JP4
SW1
SW_DIP_x01
Buck Boost
J46
u5V
J11
BB+
R4
370
D8
LED
u5V Vin
out
VBUS
J8
3.3v
out
J300
J9
ATMEGA
NC
Vcc_target out
NC (reset)
3.3v out
Vcc_5v out
GND
Vin
PC0
PC1
PC2
PC3
PC4
PC5
J3
J10
PC5
PC4
AREF
PB5−SPI_CLK
PB4−SPI_MISO
PB3−SPI_MOSI
PB2
PB1
PB0
PD7−butt_led
PD6−butt_in
PD5−LED1
PD4−LED0
PD3
PD2
PD1−USART TX
PD0−USART RX
R1
R2
150
LED
D5
D6
J12
J13
R5
100
J14
J15
R7
50
u5V
J20
R6
50
PD6−butt_in
XBEE
Vcc
SPI_MISO
J33
J35
SPI_ATTENTION
SPI_CLK
SPI_SELECT
SPI_MOSI
GPS
u3V3
Tx
Rx
GND
Vin
J48
J42
J39
Mounting Holes
J16
J17
J18
J19
C1
C2
C4
C5
C6
C7
C8
C9
C13
C14
C15
C16
J1
+5VAC
J2
−5VAC
PWR_FLAG
+5V
−5V
GND
J24
J28
Sheet: /
File: Drone.sch
Title: Drone Side
Size: A4
Date: 2020−02−29
Rev:
KiCad E.D.A. kicad (5.1.5)−3
Id: 1/1