Drone Automated Mesh Network

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SAN DIEGO STATE

ECE 496B
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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

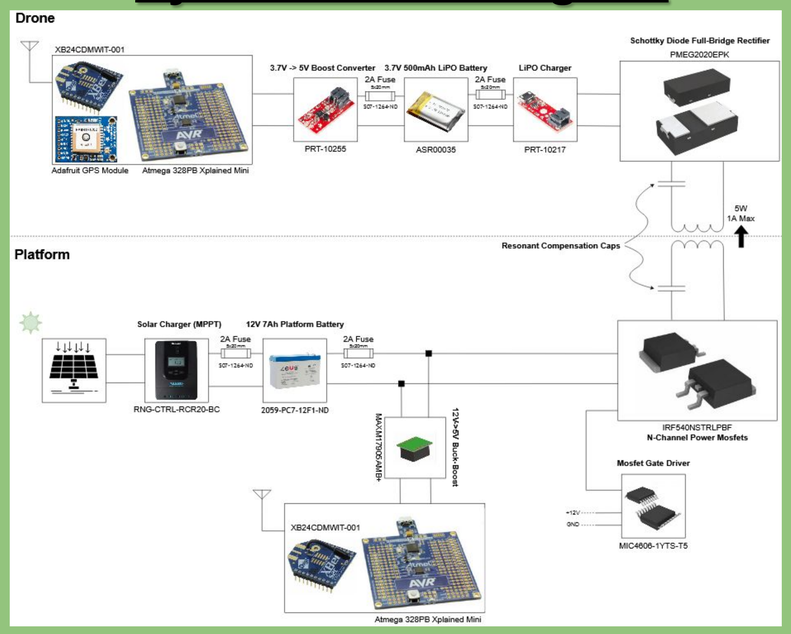
The wireless drone charging platform operates from the concept of wireless power transfer. This solution provides for more frequent use of the drone and eliminates the need for human intervention in the charging process.

Specifications

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

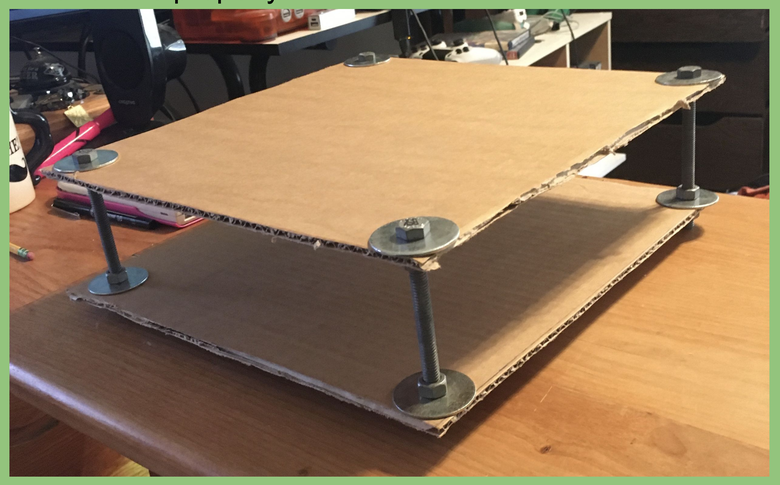
- 5W Delivered Wirelessly
- 4-7cm Charging Distance
- 120kHz Switching Frequency
- 22min Charging Time
- 7Ah Platform Battery
- 500mAh Drone Battery

System Block Diagram



System Descriptions

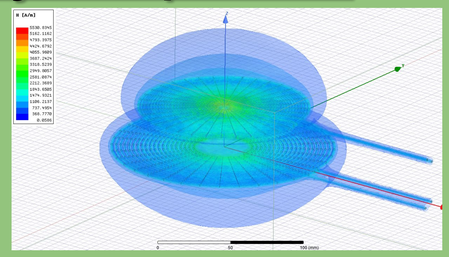
- Power Delivery
  - Ensures that the WPT and microcontrollers are supplied enough power from the solar panels to function.
- Power Management
  - Includes the rectifier and the inverter. Responsible for changing from AC to DC, and vice versa.
- Wireless Power Transfer
  - This subsystem contains the 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.

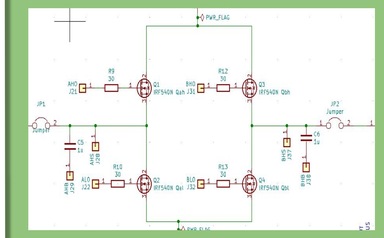


Mock Platform

Hardware / Key Components

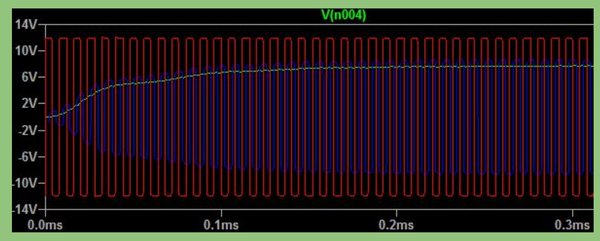
Single Coil Design
- SS compensation topology
- Coupling coeff. = 0.324
- 12.08µH Mutual Induct.

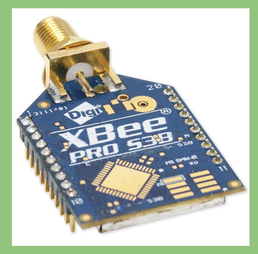




Full Bridge Inverter
- Operates at 120kHz
- 12VDC - 24Vpp AC
- IRF 540N FETS
- PWM driven, forced dead time

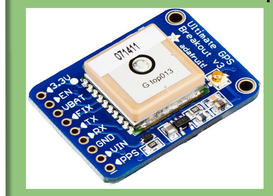
Full-Bridge Rectifier
- Schottky diodes with low 2 * 0.45V drop





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

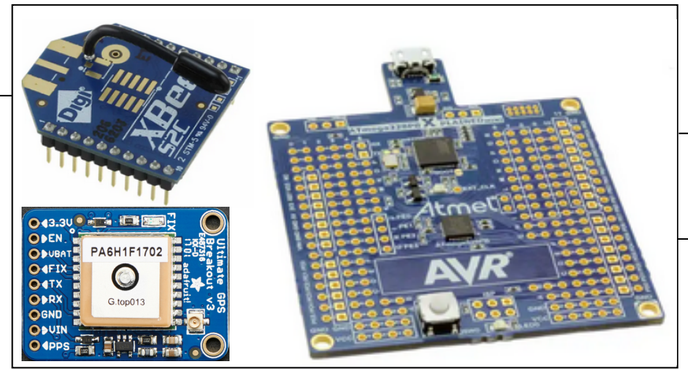
XPlained Mini Dev Board
- Processor: ATMega 328PB
- Two USART Interfaces
- Analog-Digital Converters
- 5V Power Supply



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

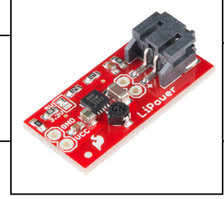
Drone

XB24CDMWIT-001



Adafruit GPS Module Atmega 328PB Xplained Mini

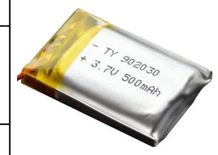
3.7V -> 5V Boost Converter



PRT-10255

2A Fuse
5x20mm
507-1264-ND

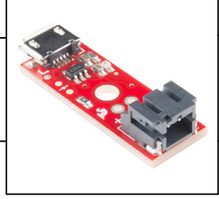
3.7V 500mAh LiPO Battery



ASR00035

2A Fuse
5x20mm
507-1264-ND

LiPO Charger



PRT-10217

Schottky Diode Full-Bridge Rectifier

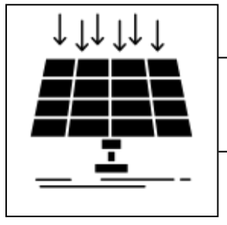
PMEG2020EPK

5W
1A Max

Resonant Compensation Caps

Platform

Solar Charger (MPPT)



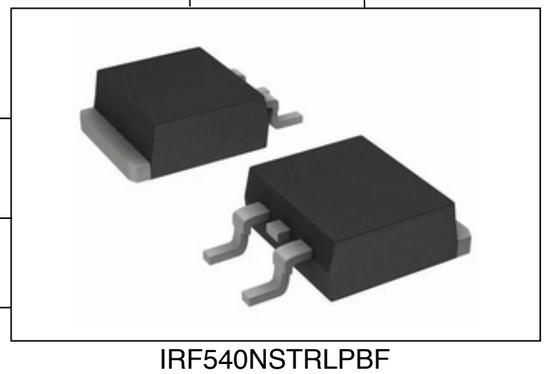
RNG-CTRL-RCR20-BC

2A Fuse
5x20mm
507-1264-ND

12V 7Ah Platform Battery

2059-PC7-12F1-ND

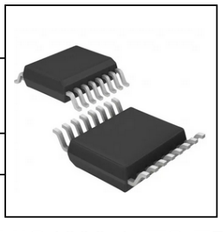
2A Fuse
5x20mm
507-1264-ND



IRF540NSTRLPBF

N-Channel Power Mosfets

Mosfet Gate Driver

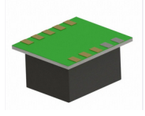


+12V
GND

MIC4606-1YTS-T5

MAXM17905AMB+

12V->5V Buck-Boost



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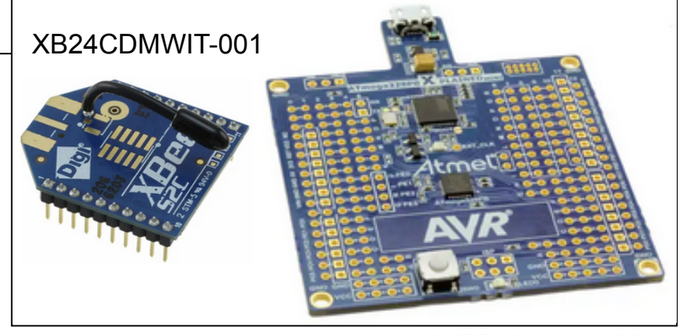
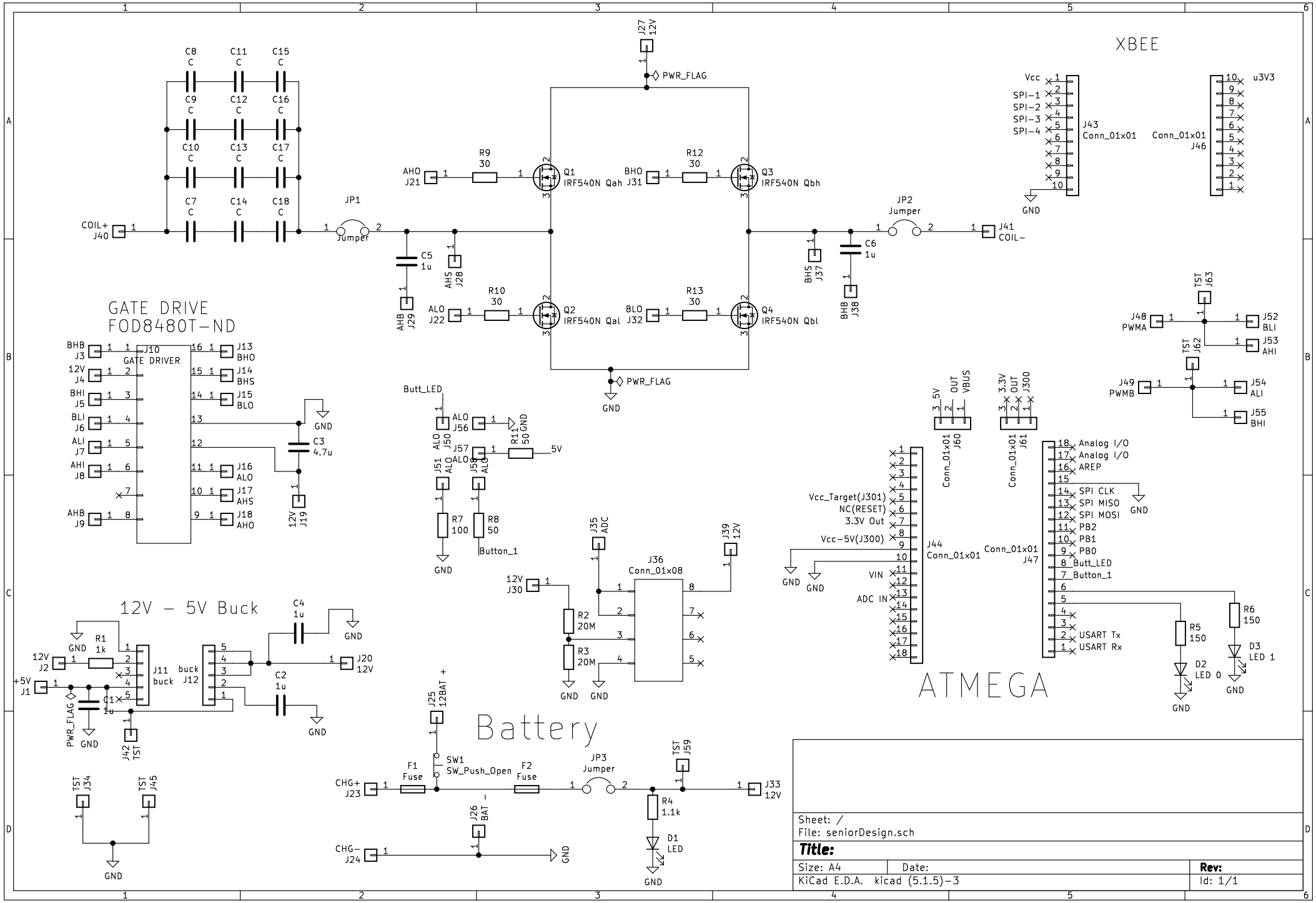


Atmega 328PB Xplained Mini


XBEE
GATE DRIVE
FOD8480T-ND
12V - 5V Buck
Battery
ATMEGA
C8 C11 C15
C9 C12 C16
C10 C13 C17
C7 C14 C18
C
COIL+ J40
JP1 Jumper
C5 1u
C6 1u
JP2 Jumper
J41 COIL-
J27 12V
PWR_FLAG
GND
AHO J21
BHO J31
ALO J22
BLO J32
R9 30
R10 30
R12 30
R13 30
Q1 IRF540N Qah
Q2 IRF540N Qal
Q3 IRF540N Qbh
Q4 IRF540N Qbl
AHS J28
AHB J29
BHS J37
BHB J38
Vcc
SPI-1
SPI-2
SPI-3
SPI-4
J43 Conn_01x01
Conn_01x01 J46
u3V3
J10 GATE DRIVER
BHB J3
12V J4
BHI J5
BLI J6
ALI J7
AHI J8
AHB J9
J13 BHO
J14 BHS
J15 BLO
J16 ALO
J17 AHS
J18 AHO
C3 4.7u
12V J19
Butt_LED
J56
J57
R11 50
R7 100
R8 50
Button_1
5V
J35 ADC
J36 Conn_01x08
J39 12V
12V J30
R2 20M
R3 20M
3.5V OUT VBUS
3.3V OUT J300
Conn_01x01 J60
Conn_01x01 J61
TST J63
J48 PWMA
J49 PWMB
J52 BLI
J53 AHI
J54 ALI
J55 BHI
TST J62
Vcc_Target(J301)
NC(RESET)
3.3V Out
Vcc-5V(J300)
VIN
ADC IN
J44 Conn_01x01
Conn_01x01 J47
Analog I/O
AREP
SPI CLK
SPI MISO
SPI MOSI
PB2
PB1
PB0
Butt_LED
Button_1
USART Tx
USART Rx
R5 150
R6 150
D2 LED 0
D3 LED 1
R1 1k
C1 1u
C2 1u
C4 1u
+5V J1
12V J2
J11 buck
buck J12
J20 12V
PWR_FLAG
J42 TST
TST J34
TST J45
J25 12BAT +
J26 BAT -
SW1 SW_Push_Open
F1 Fuse
F2 Fuse
JP3 Jumper
TST J59
CHG+ J23
CHG- J24
J33 12V
R4 1.1k
D1 LED
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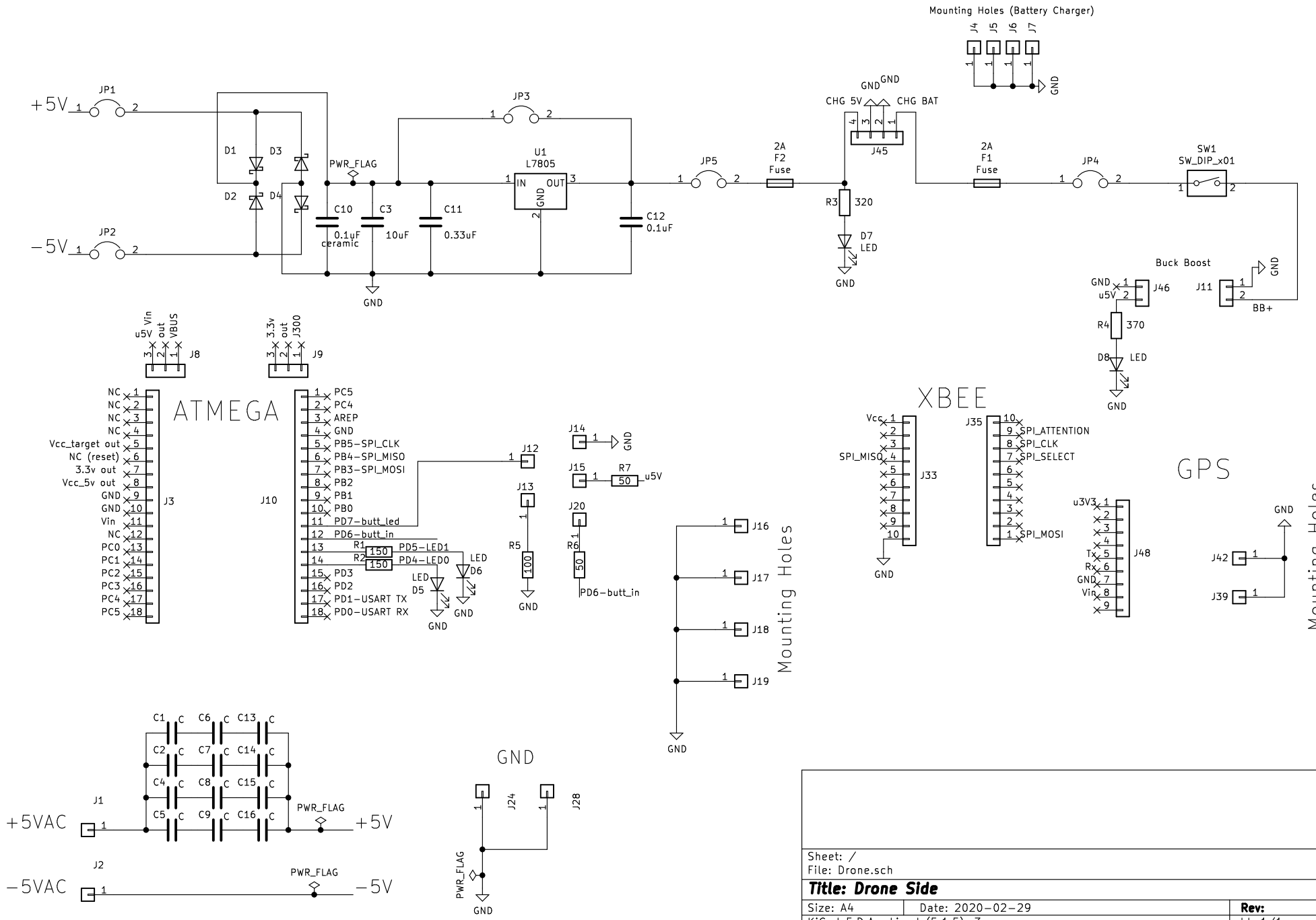
Mounting Holes (Battery Charger)
J4
J5
J6
J7
GND
+5V
JP1
D1
D3
D2
D4
PWR_FLAG
JP3
U1
L7805
IN
OUT
GND
C10
0.1uF
ceramic
C3
10uF
C11
0.33uF
C12
0.1uF
JP2
−5V
JP5
2A
F2
Fuse
GND
CHG 5V
CHG BAT
J45
R3
320
D7
LED
2A
F1
Fuse
JP4
SW1
SW_DIP_x01
Buck Boost
J46
u5V
J11
BB+
R4
370
D8
LED
u5V Vin
VBUS
J8
3.3v
J300
J9
ATMEGA
NC
Vcc_target out
NC (reset)
3.3v out
Vcc_5v out
Vin
PC0
PC1
PC2
PC3
PC4
PC5
J3
J10
PC5
PC4
AREP
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
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