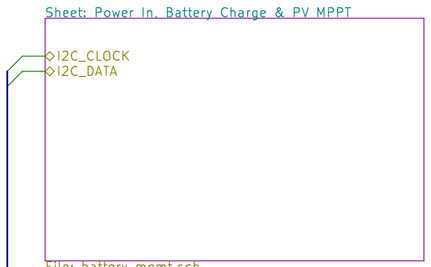

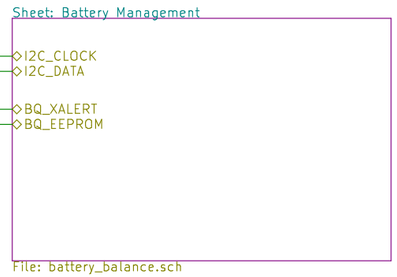

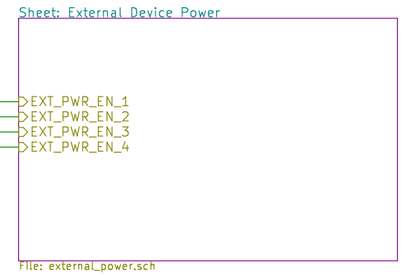

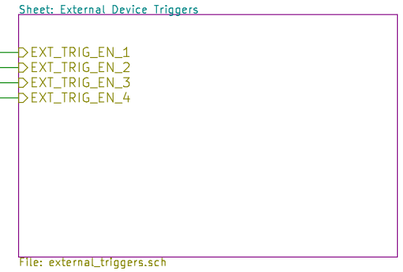

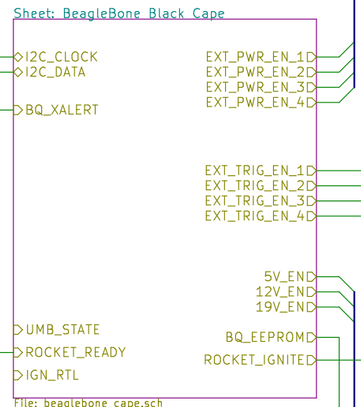

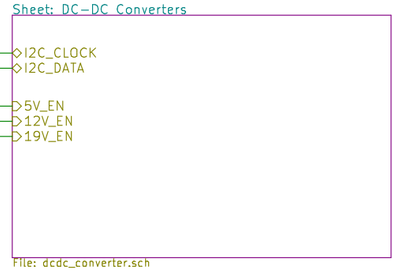

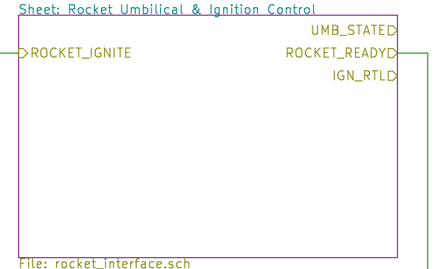

TODO:

- Finish wiring up sub-sheets.
  - Bus entries need labels on both sides!
- Create style legend.
- Consistent style:
  - No "embedded" multipliers in R vals.
- Add test points where appropriate.
  - Esp. around SMD packages, parts w/ no exposed leads, etc.
  - through-hole 2x1 pin header (1 to signal, other to gnd)

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Sheet: /
File: Launch_Tower_Computer_III.sch

Title: Launch Tower Computer 3 (LTC3)

Size: B	Date: 2016-03-11	Rev: A
KiCad E.D.A. kicad 0.201603111217+6615~~4~~3ubuntu16.04.1-product		Id: 1/8

Input Current Sense (p. 20)

Output Current Sense (p. 20)

PV_IN:
Open Circuit = 17 V
Short Circuit = 2.4 A

Supply Detection (p.15, p.34)

Input Feedback (p.14)

Shutdown (p. 27)

Battery Charge Controller
w/ MPPT

LT8490

U204

Output Feedback (p. 17)

Temp Sense (p. 21)

Feedback Resistor Disconnect

Voltage, Current, & Temp Sense

I2C addr 0x98

TODO: label pull-up resistors as no-place?

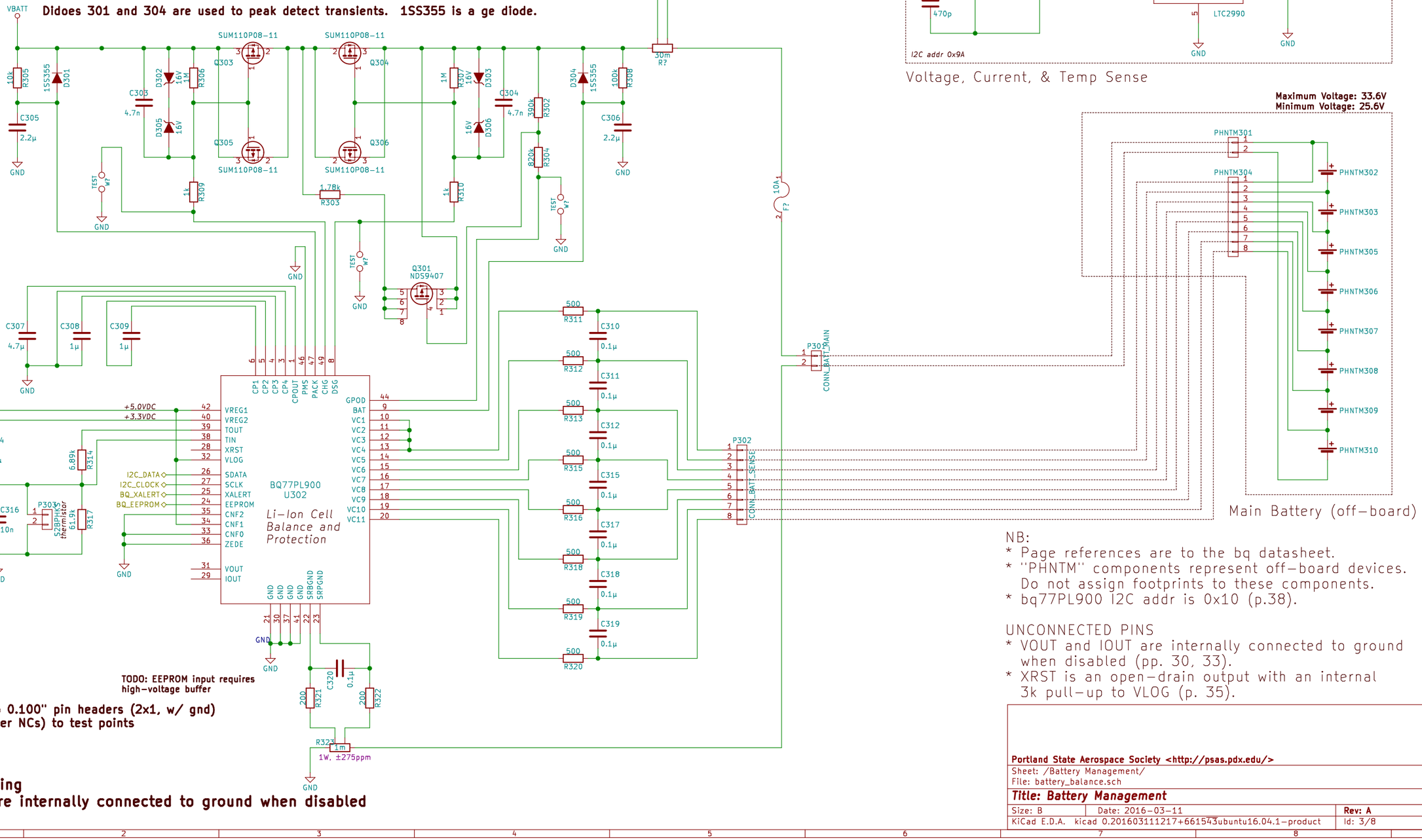
CHARGING PARAMETERS:
Stage 2 Voltage: 33.6 V
Maximum Charging Current: 10 A
Maximum Trickle Current: 1 A
Switching Frequency: 202 kHz

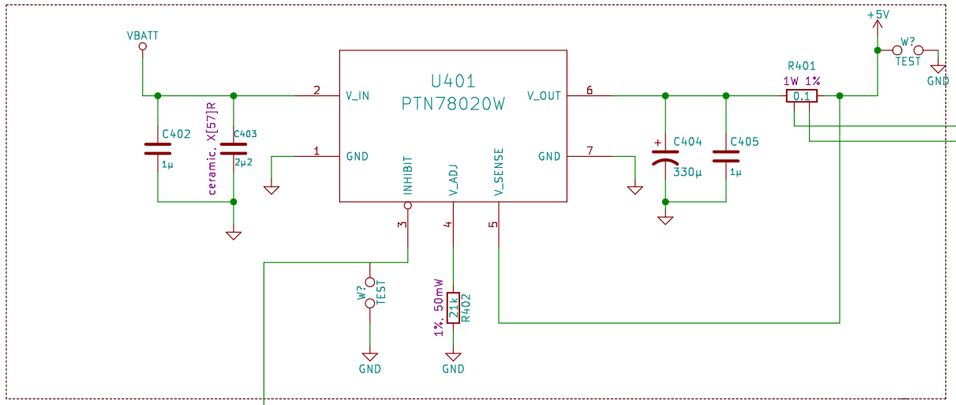
1% Resistors
75V Capacitors

Portland State Aerospace Society <http://psas.pdx.edu/>
Sheet: /Power In, Battery Charge & PV MPPT/
File: battery_mgmt.sch

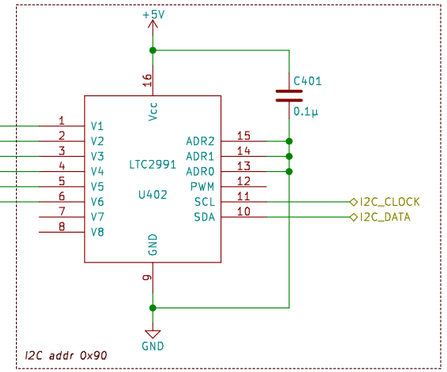
Title: Power In, Battery Charge, & PV MPPT

Size: B	Date: 2016-03-11	Rev: A
KiCad E.D.A. kicad 0.201603111217+6615~43ubuntu16.04.1-product		Id: 2/8


Didoes 301 and 304 are used to peak detect transients. 1SS355 is a ge diode.
VBATT
SUM110P08-11
Q303
Q304
Q305
Q306
1SS355
D301
D302
D303
D304
D305
D306
10k
R305
1M
R306
1M
R307
390k
R302
820k
R304
100k
R308
1k
R309
1k
R310
1.78k
R303
4.7n
C303
4.7n
C304
2.2µ
C305
2.2µ
C306
TEST
GND
30m
R?
10A
F?
Q301
NDS9407
500
R311
R312
R313
R315
R316
R318
R319
R320
C310
C311
C312
C315
C317
C318
C319
0.1µ
P301
CONN_BATT_MAIN
P302
CONN_BATT_SENSE
C307
4.7µ
C308
1µ
C309
1µ
CP1
CP2
CP3
CP4
CPOUT
PMS
PACK
CHG
DSG
+5.0VDC
+3.3VDC
C313
2.2µ
C314
2.2µ
6.89k
R314
C316
10n
P303
52PHK
thermistor
61.9k
R317
I2C_DATA
I2C_CLOCK
BQ_XALERT
BQ_EEPROM
VREG1
VREG2
TOUT
TIN
XRST
VLOG
SDATA
SCLK
XALERT
EEPROM
CNF2
CNF1
CNF0
ZEDE
VOUT
IOUT
BQ77PL900
U302
Li-Ion Cell
Balance and
Protection
GPOD
BAT
VC1
VC2
VC3
VC4
VC5
VC6
VC7
VC8
VC9
VC10
VC11
GND
SRBGND
SRPGND
C320
0.1µ
200
R321
200
R322
R323
1m
1W, ±275ppm
TODO: EEPROM input requires
high-voltage buffer
TODO:
* connect BQ_EEPROM to 0.100" pin headers (2x1, w/ gnd)
* connect XRST (and other NCs) to test points
* XRST is left floating
* VOUT and IOUT are internally connected to ground when disabled
Temp. Sense, Battery
Q302
MMBT3904
C302
470p
U301
LTC2990
+5V
Vcc
V1
V2
V3
V4
ADR1
ADR0
SDL
SDA
I2C_CLOCK
I2C_DATA
C301
0.1µ
5k6
R301
I2C addr 0x9A
Voltage, Current, & Temp Sense
Maximum Voltage: 33.6V
Minimum Voltage: 25.6V
PHNTM301
PHNTM304
PHNTM302
PHNTM303
PHNTM305
PHNTM306
PHNTM307
PHNTM308
PHNTM309
PHNTM310
Main Battery (off-board)
NB:
* Page references are to the bq datasheet.
* "PHNTM" components represent off-board devices.
Do not assign footprints to these components.
* bq77PL900 I2C addr is 0x10 (p.38).
UNCONNECTED PINS
* VOUT and IOUT are internally connected to ground
when disabled (pp. 30, 33).
* XRST is an open-drain output with an internal
3k pull-up to VLOG (p. 35).
Portland State Aerospace Society <http://psas.pdx.edu/>
Sheet: /Battery Management/
File: battery_balance.sch
Title: Battery Management
Size: B
Date: 2016-03-11
Rev: A
KiCad E.D.A. kicad 0.201603111217+661543ubuntu16.04.1-product
Id: 3/8

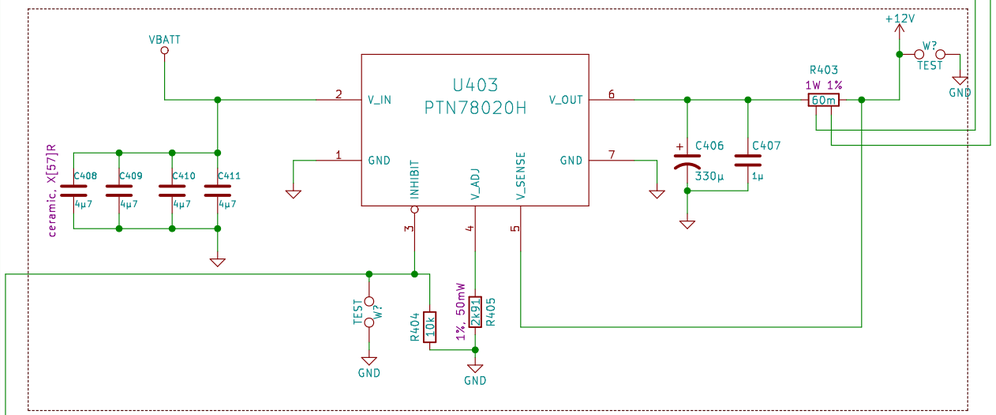


+5V DC Rail

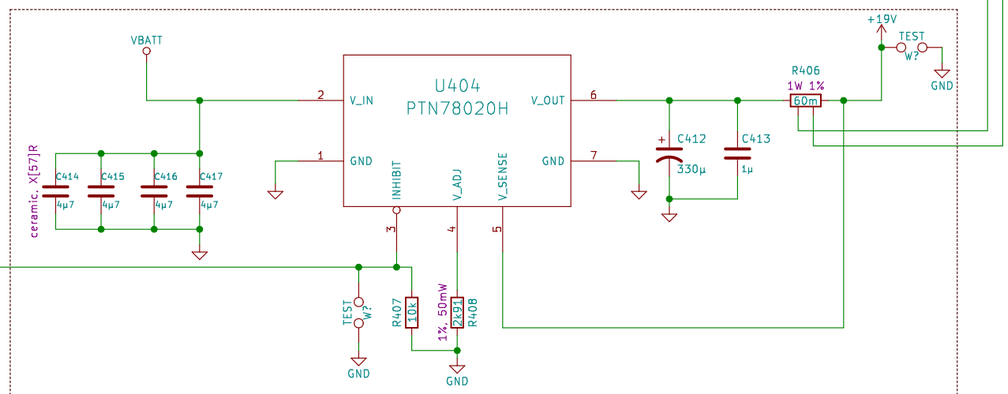


Voltage, Current, & Temp Sense

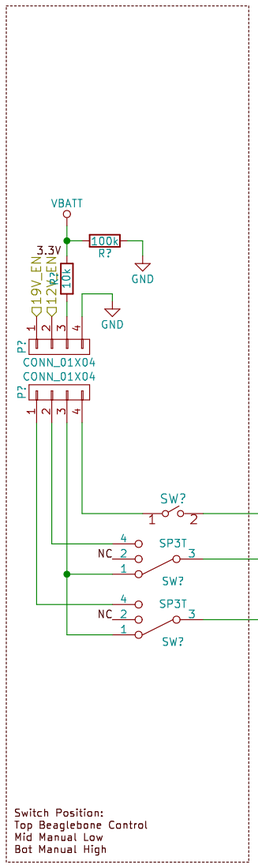
Current Sense Resistors
full-scale voltage = 0.300 V
R_sense_max = 0.300/Imax
1 A = 300mΩ
3 A = 100mΩ
5 A = 60mΩ
10 A = 30mΩ



+12V DC Rail



+19V DC Rail

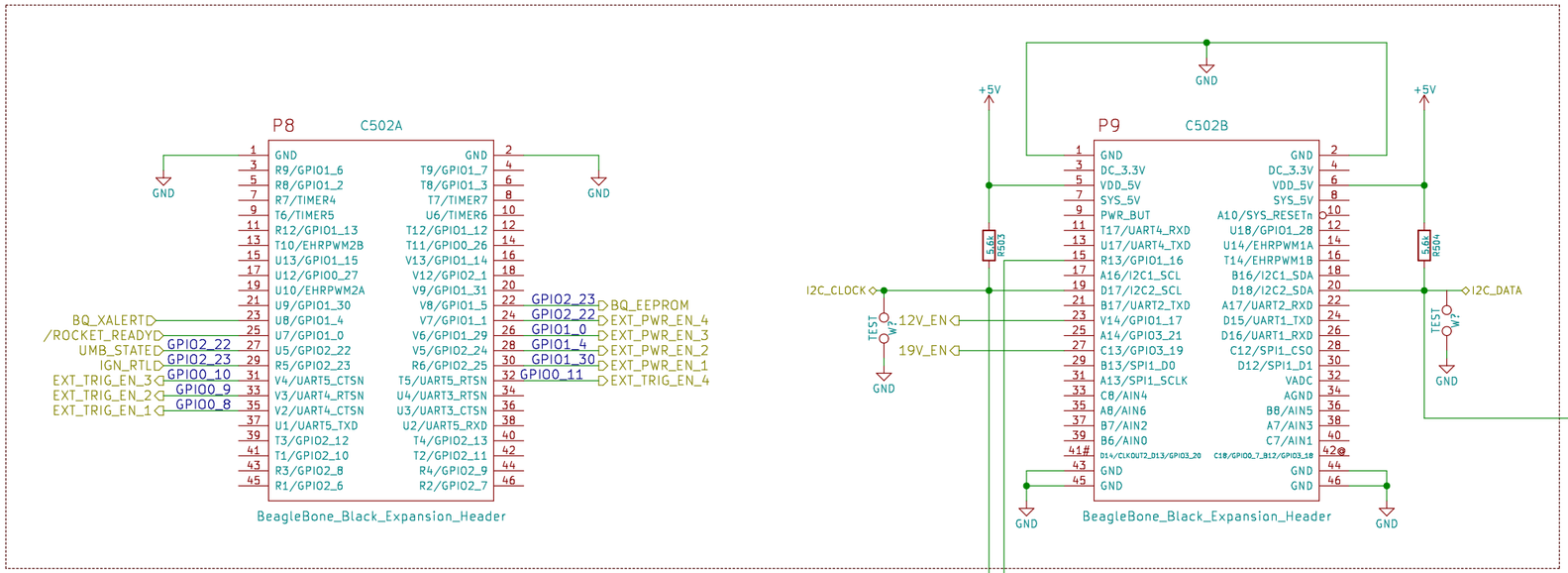


Inhibit Control

NB:
1. V_sense should connect as close as possible to the largest load on the given power rail.
2. Place Rset resistors as close to package pins as possible.
3. Ceramic (Cin) capacitors should be located within 0.5 in of the input pins.
4. We may need heat sinks on the converters. The datasheet indicates a range of 2W to 5W of power dissipation given our specs.
5. Pay attention to the datasheet's recommendations regarding capacitor selection.

TODO:
* ~~jumpers on all INHIBIT pins~~
* ~~Values for converter enable pull-down resistors. Don't exceed the BB's low source max.!~~
* ~~Capacitor values are minimums. Consider increasing these. Consult datasheet for more info.~~

Portland State Aerospace Society <http://psas.pdx.edu/>		
Sheet: /DC-DC Converters/ File: dcdc_converter.sch		
Title: LTC3 DC-DC Converters		
Size: B	Date: 2016-03-11	**Rev: A**
KiCad E.D.A. kicad 0.201603111217+6615~43ubuntu16.04.1-product		Id: 4/8



NOTES:
* Do NOT change ROCKET_IGNITE, pin default reset state is High-Z w/ pulldown resistor. Other pins can be configured in EEPROM at boot time.
* All I2C devices on LTC3 are slaves. The BBB is the only master so the LTC will not need arbitration.

I2C Devices

ADDR	Part	Type	Location
0x10	U203	BQ77PL900	B/PM
0x54	U501	EEPROM	BBB
0x90	U402	LTC2991	DC-DC
0x98	U203	LTC2990	Power In
0x9A	U301	LTC2990	B/PM

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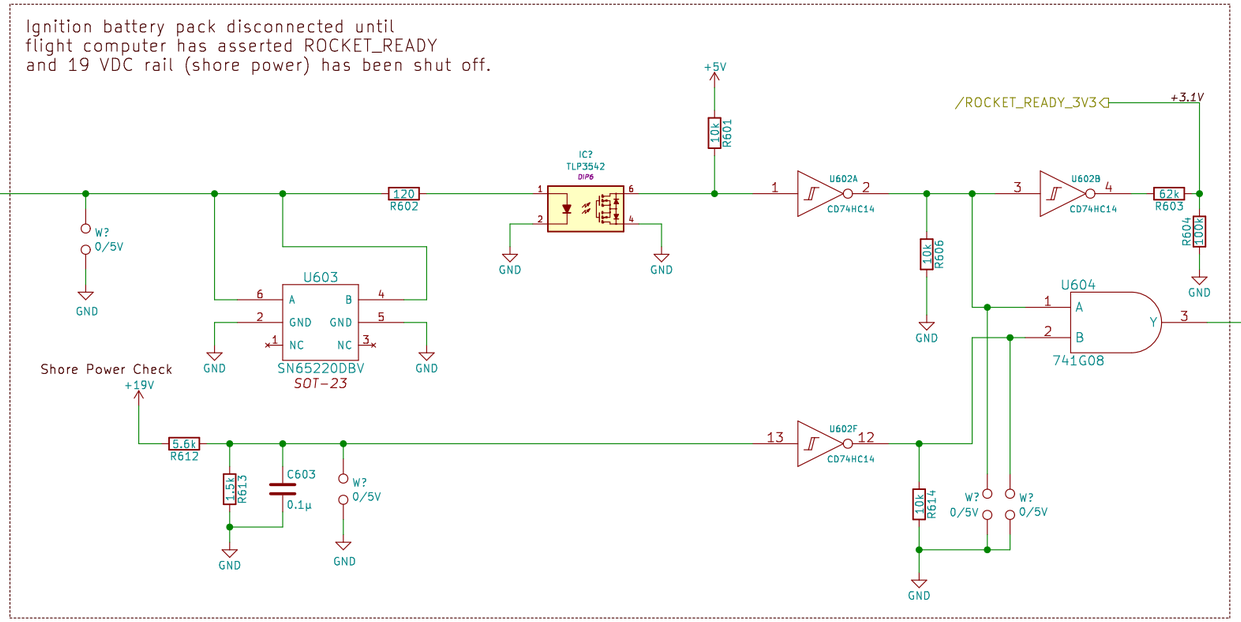
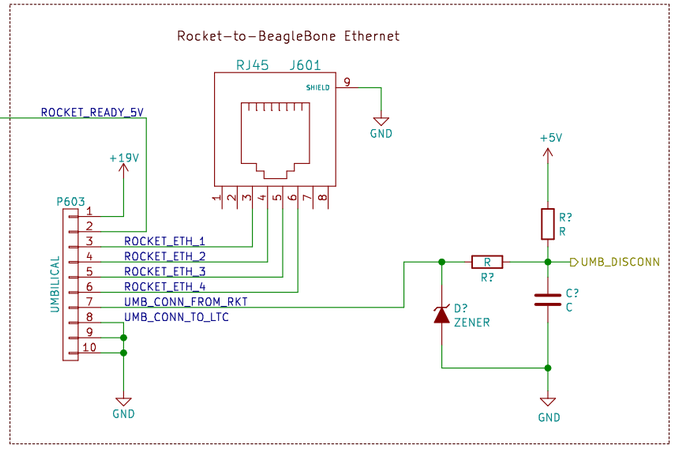
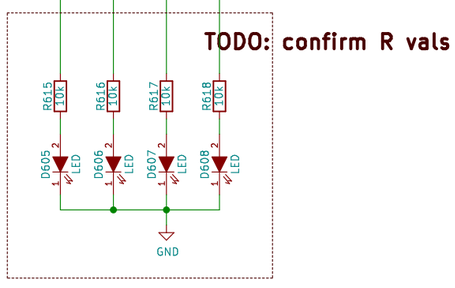
Sheet: /BeagleBone Black Cape/
File: beaglebone_cape.sch

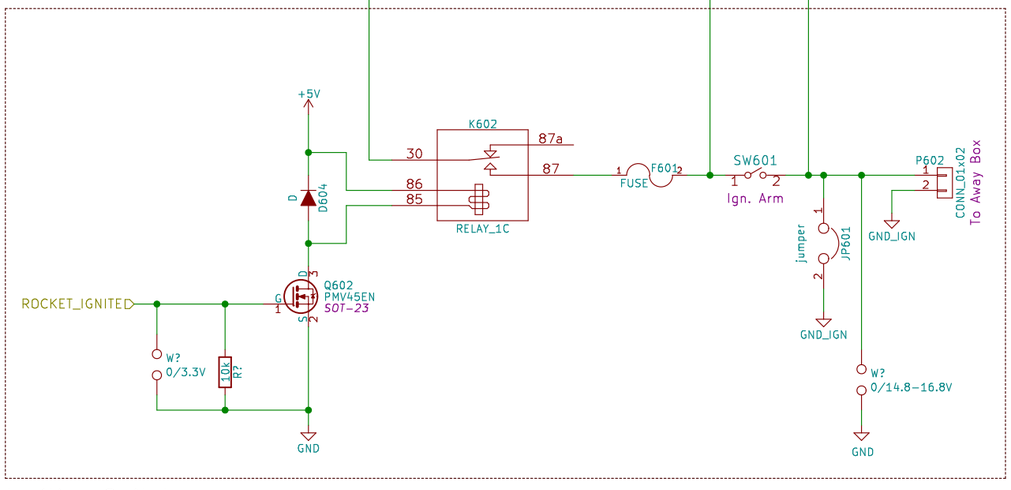
Title: LTC3 BeagleBone Black Cape Interface

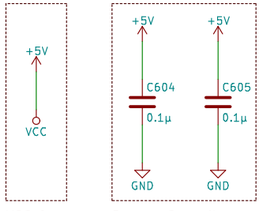
Size: B	Date: 2016-03-11	**Rev: A**
KiCad E.D.A. kicad 0.201603111217+6615~~4~~3ubuntu16.04.1-product		Id: 5/8











TODO:
* **Select appropriate component values.**
* **Finish rocket umbilical connector.**
  * **Add umbilical connect sense lines circuitry.**
* **Label various LEDs.**

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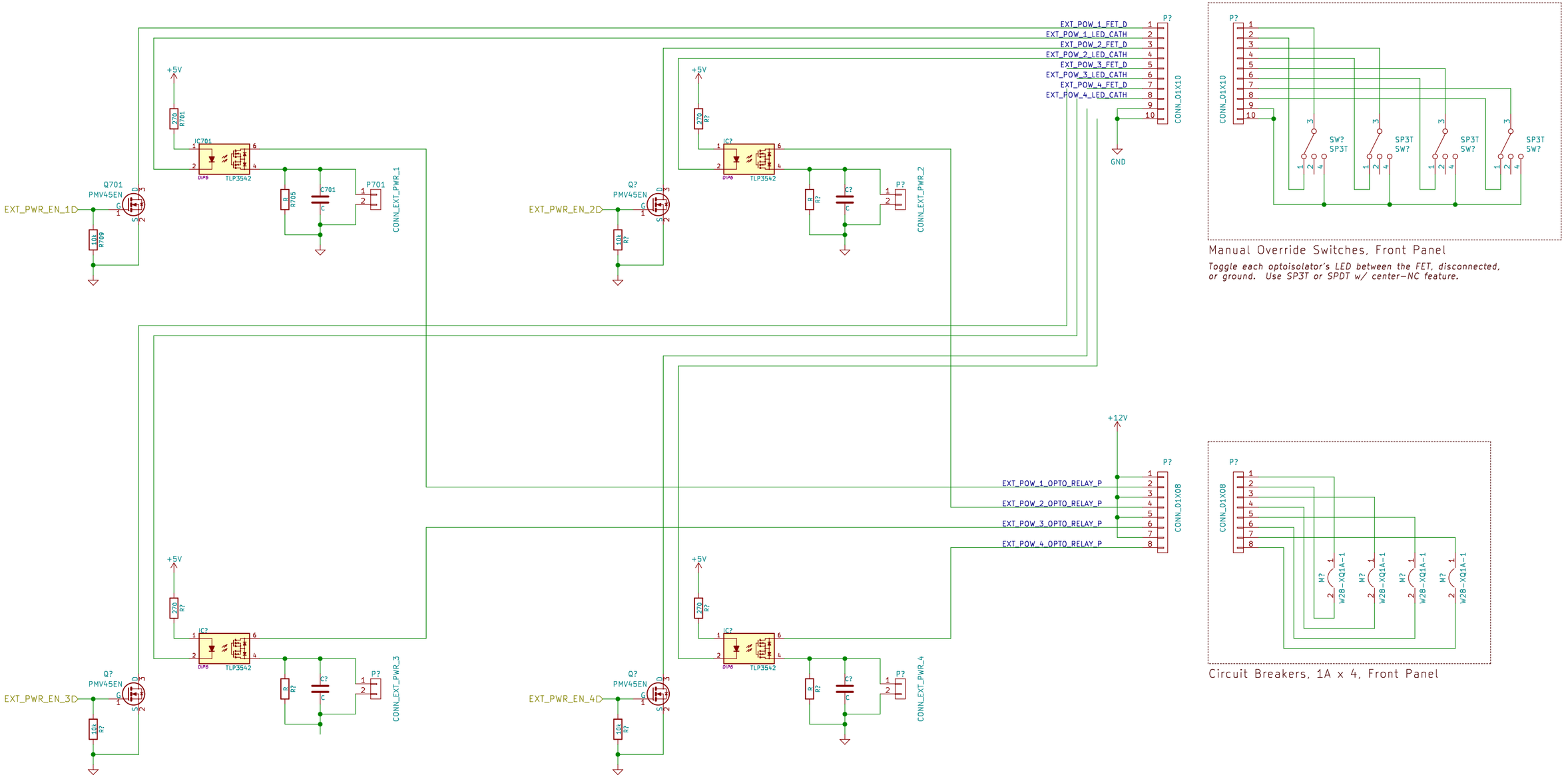
Sheet: /Rocket Umbilical & Ignition Control/
File: rocket_interface.sch

Title: LTC3 Rocket Umbilical & Ignition Control

Size: B	Date: 2016-03-11	**Rev: A**
KiCad E.D.A.	kicad 0.201603111217+661543ubuntu16.04.1-product	Id: 6/8



Manual Override Switches, Front Panel

Toggle each optoisolator's LED between the FET, disconnected, or ground. Use SP3T or SPDT w/ center-NC feature.

Circuit Breakers, 1A x 4, Front Panel

TODO:
*** Determine values for bleeder resistor and filter capacitor on each power output.**

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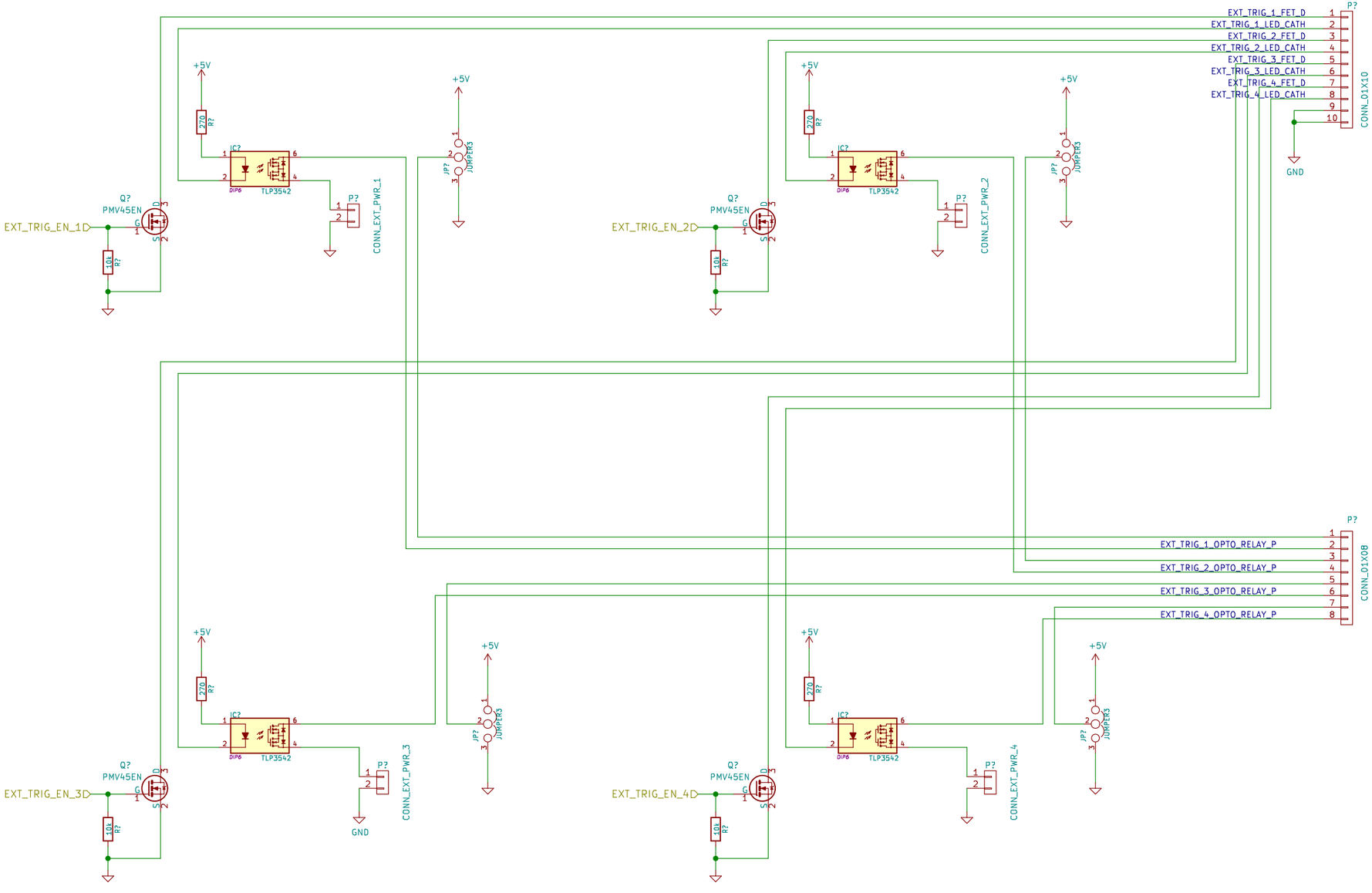
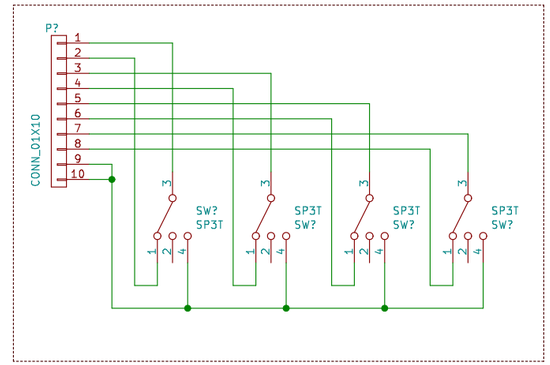
Sheet: /External Device Power/
File: external_power.sch

Title: LTC3 External Device Power

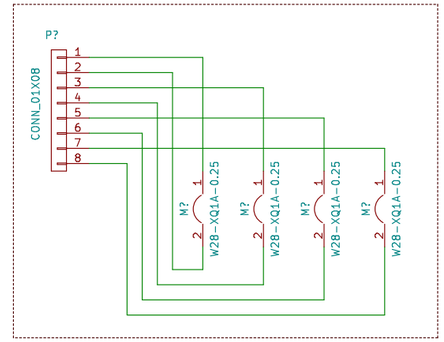
Size: B	Date: 2016-03-11	**Rev: A**
KiCad E.D.A. kicad 0.201603111217+6615~~4~~3ubuntu16.04.1-product		Id: 7/8





Manual Override Switches, Front Panel

Toggle each optoisolator's LED between the FET, disconnected, or ground. Use SP3T or SPDT w/ center-NC feature.



Circuit Breakers, 250mA x 4, Front Panel

Portland State Aerospace Society <http://psas.pdx.edu/>

Sheet: /External Device Triggers/
File: external_triggers.sch

Title: LTC3 External Device Triggers

Size: B	Date: 2016-03-11	**Rev: A**
KiCad E.D.A. kicad 0.201603111217+6615~ubuntu16.04.1-product		Id: 8/8