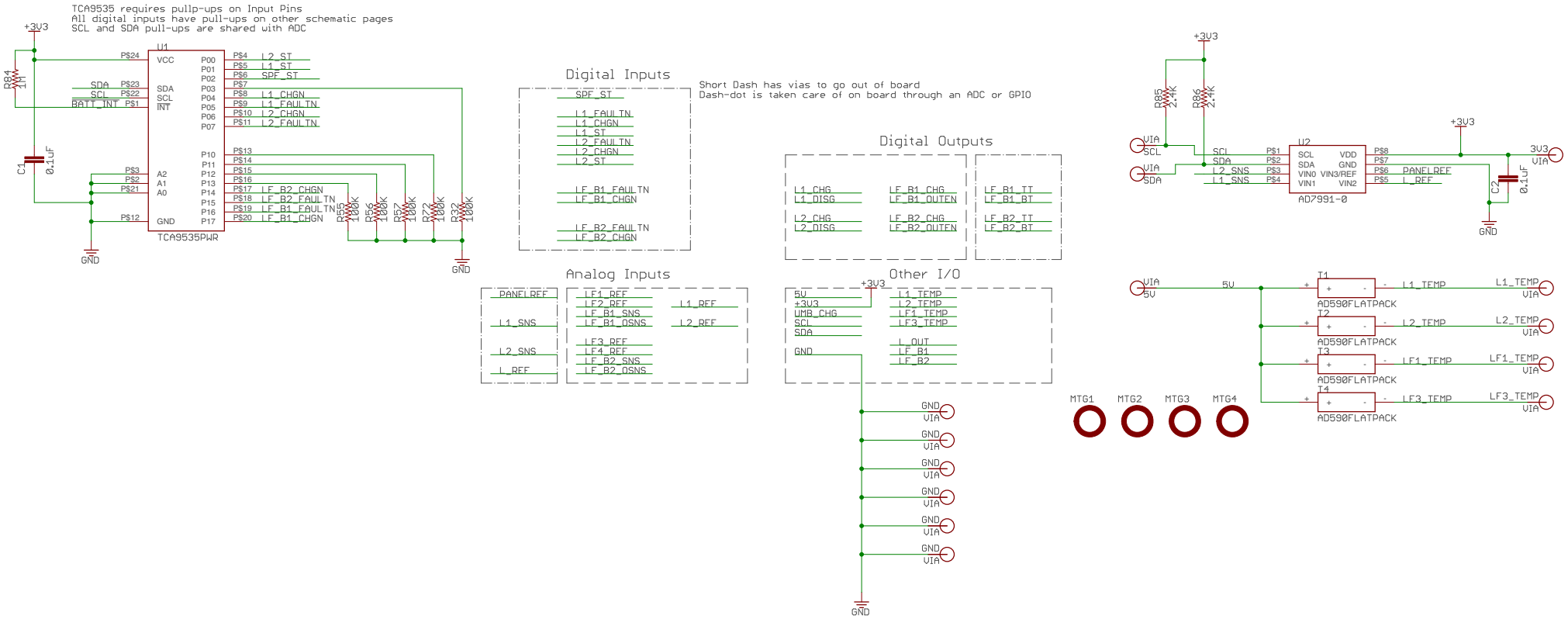
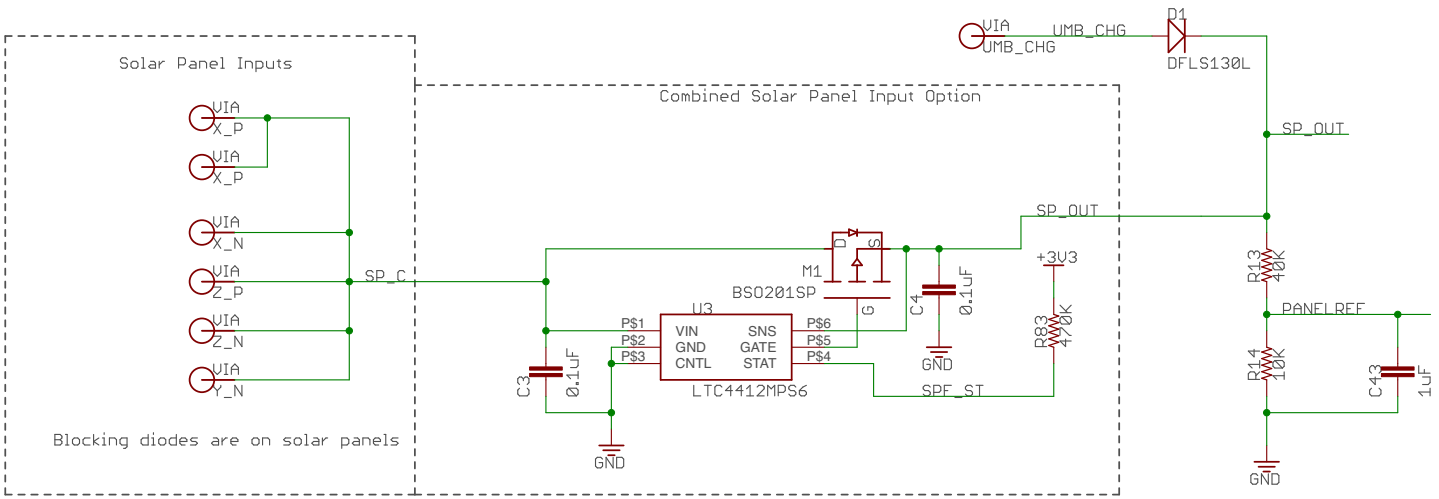
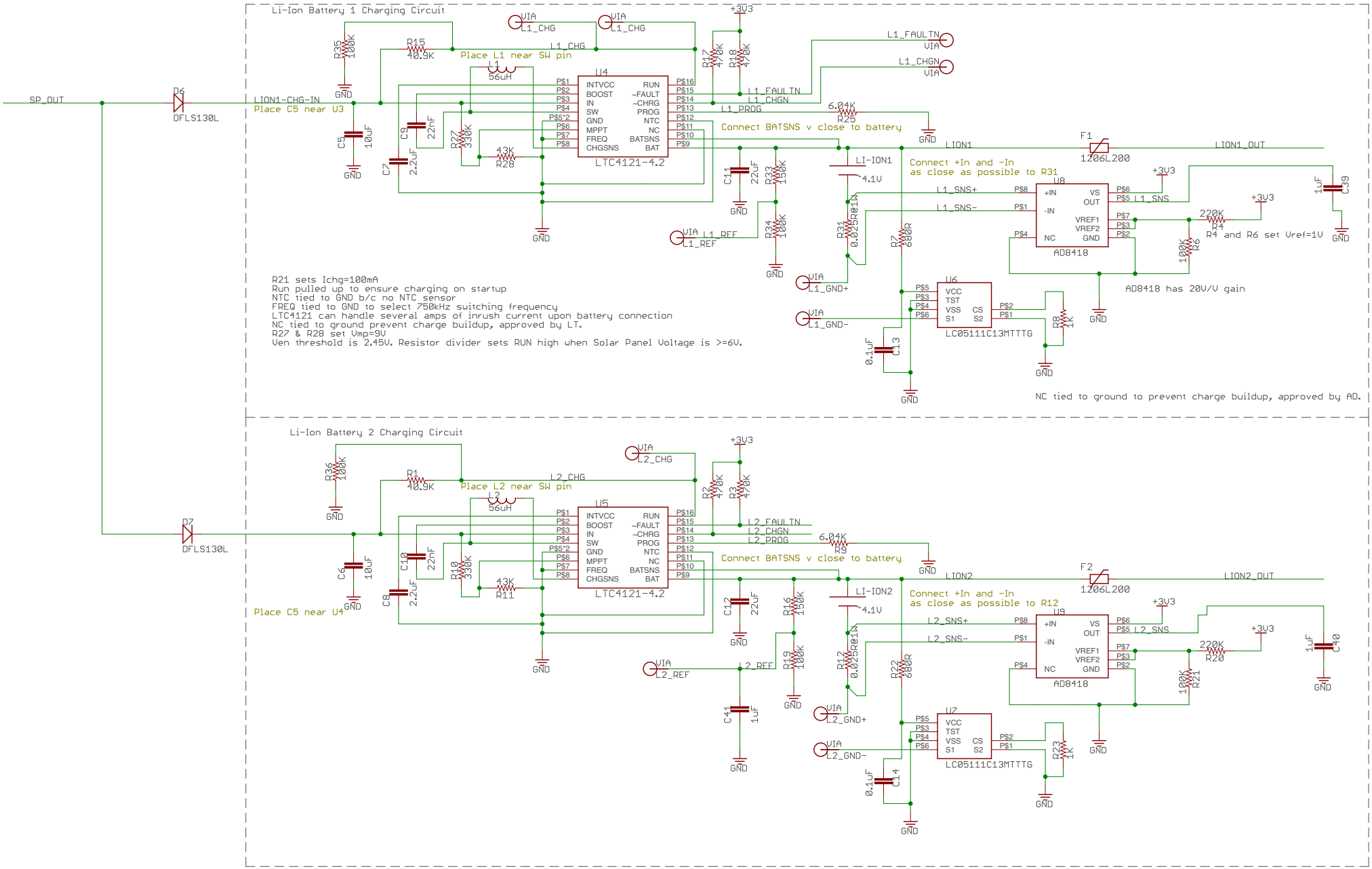
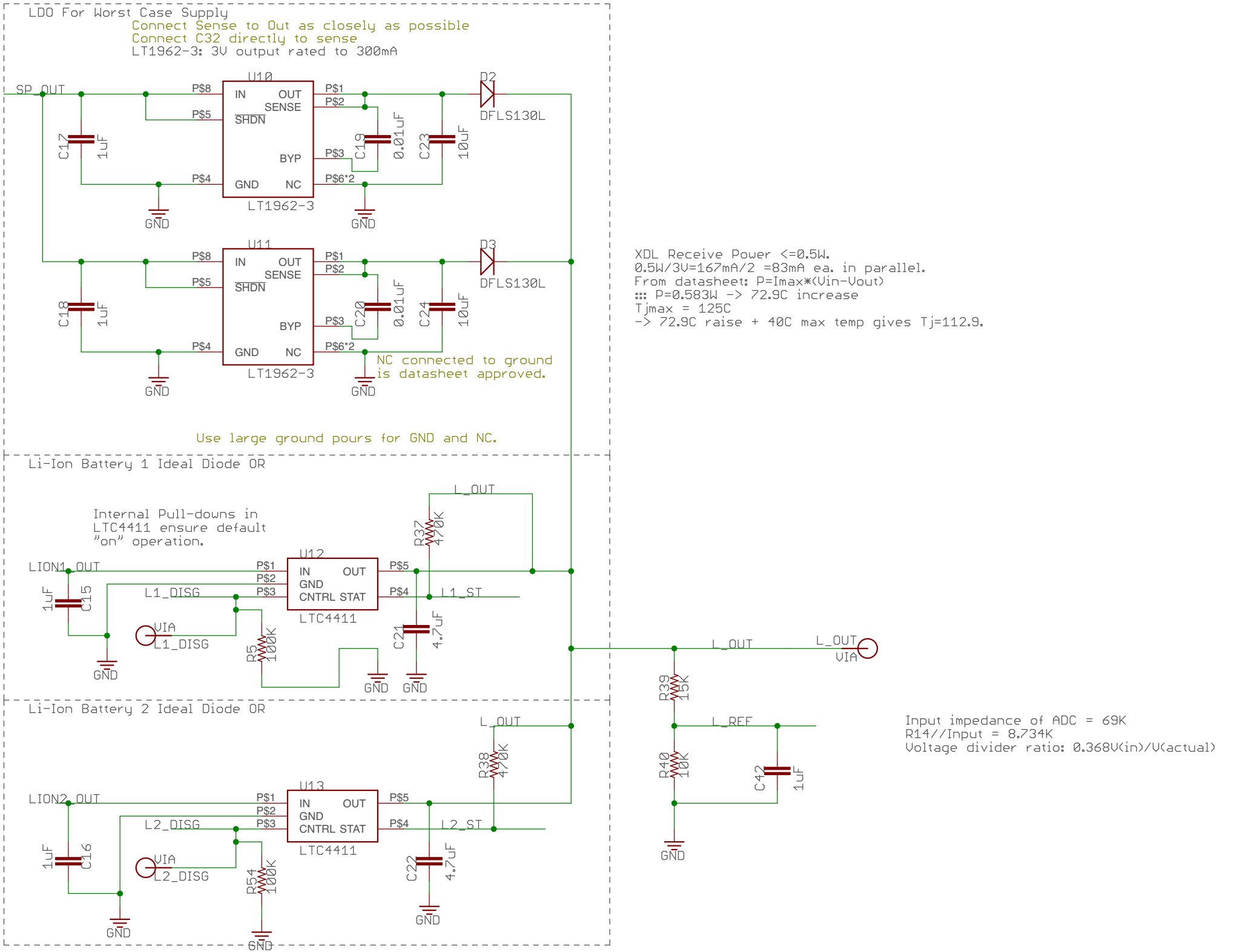

TCA9535 requires pullp-ups on Input Pins
All digital inputs have pull-ups on other schematic pages
SCL and SDA pull-ups are shared with ADC
+3V3
R84
1M
C1
0.1uF
GND
U1
VCC
SDA
SCL
INT
GND
A2
A1
A0
P00
P01
P02
P03
P04
P05
P06
P07
P10
P11
P12
P13
P14
P15
P16
P17
TCA9535PWR
PS24
PS23
PS22
PS1
PS3
PS2
PS21
PS12
PS4 L2_ST
PS5 L1_ST
PS6 SPF_ST
PS7
PS8 L1_CHGN
PS9 L1_FAULTN
PS10 L2_CHGN
PS11 L2_FAULTN
PS13
PS14
PS15
PS16
PS17 LF_B2_CHGN
PS18 LF_B2_FAULTN
PS19 LF_B1_FAULTN
PS20 LF_B1_CHGN
R55 100K
R56 100K
R57 100K
R72 100K
R73 100K
Digital Inputs
Short Dash has vias to go out of board
Dash-dot is taken care of on board through an ADC or GPIO
SPF_ST
L1_FAULTN
L1_CHGN
L1_ST
L2_FAULTN
L2_CHGN
L2_ST
LF_B1_FAULTN
LF_B1_CHGN
LF_B2_FAULTN
LF_B2_CHGN
Digital Outputs
L1_CHG
L1_DISG
L2_CHG
L2_DISG
LF_B1_CHG
LF_B1_OUTEN
LF_B2_CHG
LF_B2_OUTEN
LF_B1_TT
LF_B1_BT
LF_B2_TT
LF_B2_BT
Analog Inputs
PANELREF
L1_SNS
L2_SNS
L_REF
LF1_REF
LF2_REF
LF_B1_SNS
LF_B1_OSNS
LF3_REF
LF4_REF
LF_B2_SNS
LF_B2_OSNS
L1_REF
L2_REF
Other I/O
+3V3
5V
+3V3
VMB_CHG
SCL
SDA
GND
L1_TEMP
L2_TEMP
LF1_TEMP
LF3_TEMP
L_OUT
LF_B1
LF_B2
GND
VIA
GND
VIA
GND
VIA
GND
VIA
GND
VIA
GND
VIA
GND
+3V3
R85
2.4K
R86
2.4K
VIA
SCL
VIA
SDA
U2
SCL
SDA
VIN0
VIN1
VDD
GND
VIN3/REF
VIN2
PS1
PS2
PS3
PS4
PS8
PS7
PS6
PS5
L2_SNS
L1_SNS
PANELREF
L_REF
AD7991-0
+3V3
3V3
VIA
C2
0.1uF
GND
VIA
5V
5V
T1
T2
T3
T4
AD590FLATPACK
AD590FLATPACK
AD590FLATPACK
AD590FLATPACK
L1_TEMP
L2_TEMP
LF1_TEMP
LF3_TEMP
L1_TEMP
VIA
L2_TEMP
VIA
LF1_TEMP
VIA
LF3_TEMP
VIA
MTG1
MTG2
MTG3
MTG4

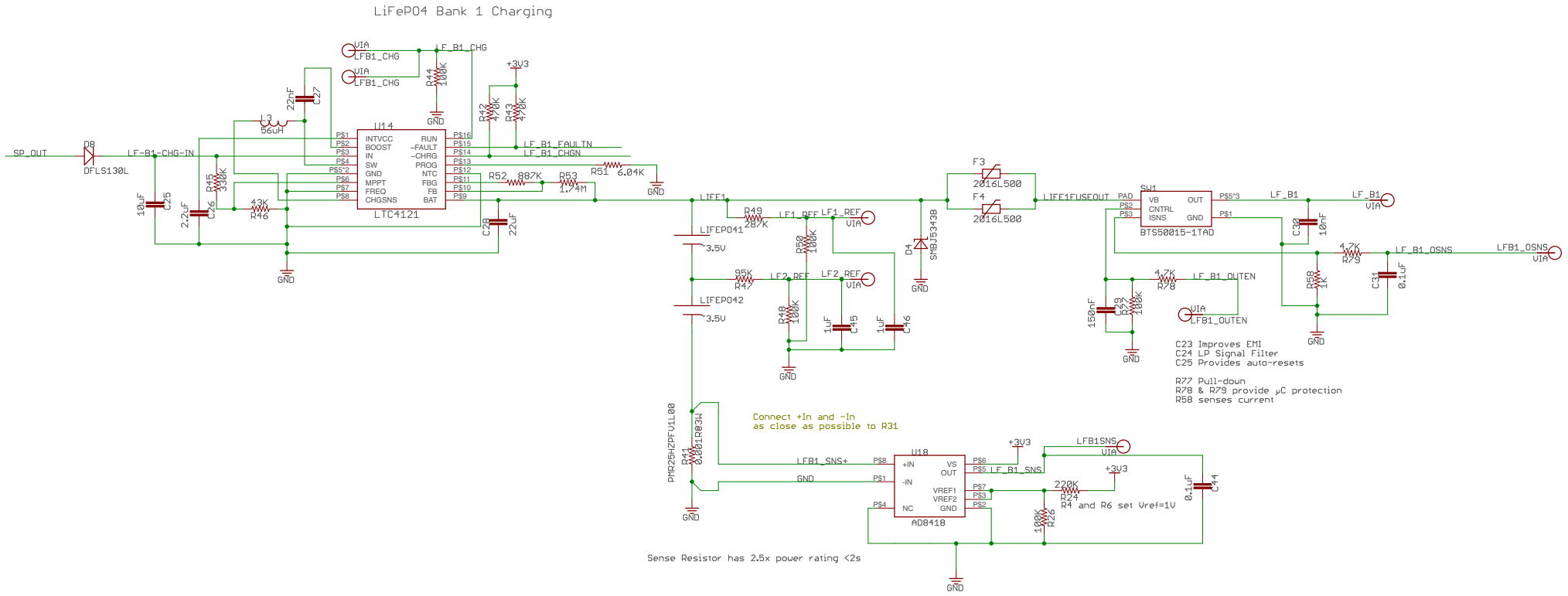
# Solar Panel Front End

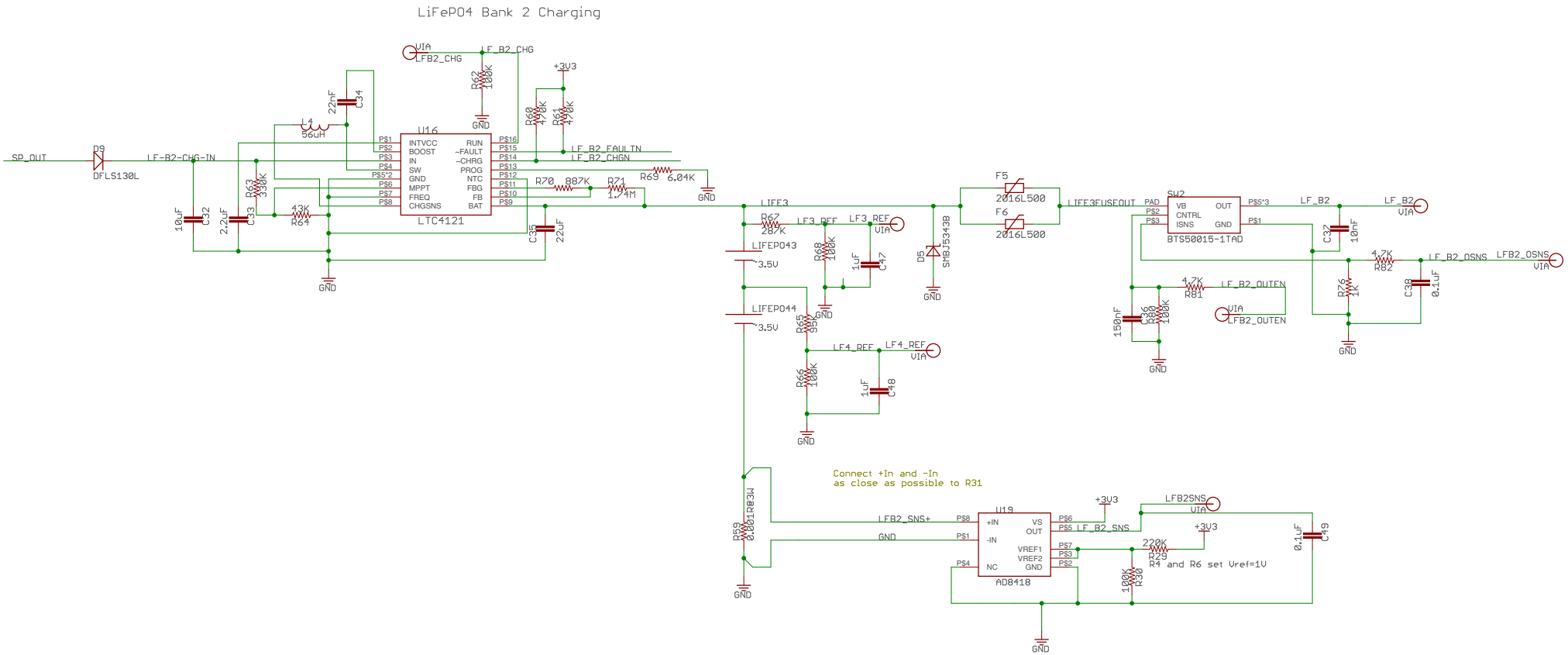



Input impedance of ADC = 69K
R14//Input = 8.734K
Voltage divider ratio: 0.1792V(in)/V(actual)


Place GND vias under U3 and U4.
Connect all caps to ground plane.
VIAs added for debugging circuit functionality.
Li-Ion Battery 1 Charging Circuit
SP_OUT
D6
DFLS130L
LION1-CHG-IN
Place C5 near U3
R35 100K
R15 40.9K
L1 56uH
Place L1 near SW pin
U4
LTC4121-4.2
INTVCC
BOOST
IN
SW
GND
MPPT
FREQ
CHGSNS
RUN
~FAULT
~CHRG
PROG
NTC
BATSNS
BAT
C5 10uF
C9 22nF
C7 2.2uF
R27 330K
R28 43K
R17 4.70K
R18 4.70K
L1_FAULTN
L1_CHGN
L1_CHG
L1_FAULTN
L1_CHGN
L1_PROG
R25 6.04K
Connect BATSNS v close to battery
LION1
F1
1206L200
LION1_OUT
LI-ION1
4.1V
C11 22uF
R33 150K
R24 100K
L1_REF
R31 0.025Re1%
R7 680R
Connect +In and -In
as close as possible to R31
L1_SNS+
L1_SNS-
U8
AD8418
+IN
-IN
VS
OUT
VREF1
VREF2
NC
GND
L1_SNS
R4 220K
R4 and R6 set Vref=1V
R6 100K
C39 1uF
AD8418 has 20V/V gain
L1_GND+
L1_GND-
U6
LC05111C13MTTTG
VCC
TST
VSS
CS
S1
S2
C13 0.1uF
R8 1K
NC tied to ground to prevent charge buildup, approved by AD.
R21 sets Ichg=100mA
Run pulled up to ensure charging on startup
NTC tied to GND b/c no NTC sensor
FREQ tied to GND to select 750kHz switching frequency
LTC4121 can handle several amps of inrush current upon battery connection
NC tied to ground prevent charge buildup, approved by LT.
R27 & R28 set Vmp=9V
Ven threshold is 2.45V. Resistor divider sets RUN high when Solar Panel Voltage is >=6V.
Li-Ion Battery 2 Charging Circuit
D7
DFLS130L
Place C5 near U4
R36 100K
R1 40.9K
L2 56uH
Place L2 near SW pin
U5
LTC4121-4.2
C6 10uF
C10 22nF
C8 2.2uF
R10 330K
R11 43K
R2 4.70K
R3 4.70K
L2_CHG
L2_FAULTN
L2_CHGN
L2_PROG
R5 6.04K
Connect BATSNS v close to battery
LION2
F2
1206L200
LION2_OUT
LI-ION2
4.1V
C12 22uF
R16 150K
R19 100K
L2_REF
R12 0.025Re1%
R22 680R
Connect +In and -In
as close as possible to R12
L2_SNS+
L2_SNS-
U9
AD8418
L2_SNS
R20 220K
R21 100K
C40 1uF
L2_GND+
L2_GND-
U7
LC05111C13MTTTG
C14 0.1uF
R23 1K


LDO For Worst Case Supply
Connect Sense to Out as closely as possible
Connect C32 directly to sense
LT1962-3: 3V output rated to 300mA
SP_OUT
U10
IN
OUT
SENSE
SHDN
BYP
GND
NC
P$8
P$5
P$4
P$1
P$2
P$3
P$6*2
LT1962-3
C17
1uF
C19
0.01uF
C23
10uF
D2
DFLS130L
GND
U11
C18
1uF
C20
0.01uF
C24
10uF
D3
DFLS130L
NC connected to ground
is datasheet approved.
Use large ground pours for GND and NC.
XDL Receive Power <=0.5W.
0.5W/3V=167mA/2 =83mA ea. in parallel.
From datasheet: P=Imax*(Vin-Vout)
::: P=0.583W -> 72.9C increase
Tjmax = 125C
-> 72.9C raise + 40C max temp gives Tj=112.9.
Li-Ion Battery 1 Ideal Diode OR
Internal Pull-downs in
LTC4411 ensure default
"on" operation.
L_OUT
R37
470K
U12
LION1_OUT
L1_DISG
L1_ST
GND
CNTRL
STAT
LTC4411
C15
1uF
VIA
R5
100K
C21
4.7uF
L_OUT
VIA
R39
15K
L_REF
R40
10K
C42
1uF
Input impedance of ADC = 69K
R14//Input = 8.734K
Voltage divider ratio: 0.368V(in)/V(actual)
Li-Ion Battery 2 Ideal Diode OR
R38
470K
U13
LION2_OUT
L2_DISG
L2_ST
C16
1uF
R54
100K
C22
4.7uF


LiFePO4 Bank 1 Charging
VIA
LFB1_CHG
LF_B1_CHG
+3V3
R44 100K
R42 100K
R43 470K
C27 22nF
L3 56uH
U14
LTC4121
INTVCC
BOOST
IN
SW
GND
MPPT
FREQ
CHGSNS
RUN
~FAULT
~CHRG
PROG
NTC
FBG
FB
BAT
LF_B1_FAULTN
LF_B1_CHGN
R52 887K
R53 1.74M
R51 6.04K
GND
SP_OUT
D8
DFLS130L
LF-B1-CHG-IN
R45 330K
C25 10uF
C26 2.2uF
R46 43K
C28 22uF
LIFE1
R49 287K
LF1_REF
LIFEPO41
3.5V
R50 100K
D4
SMBJ53438
R47 95K
LF2_REF
LIFEPO42
R48 100K
C45 1uF
C46 1uF
F3
2016L500
F4
2016L500
LIFE1FUSEOUT
SW1
BTS50015-1TAD
PAD
VB
CNTRL
ISNS
OUT
GND
PS5*3
PS1
LF_B1
C30 10nF
4.7K
LF_B1_OSNS
LFB1_OSNS
R59
C34 0.1uF
R58 1K
R77 4.7K
LF_B1_OUTEN
LFB1_OUTEN
C23 150nF
C24 100K
C23 Improves EMI
C24 LP Signal Filter
C25 Provides auto-resets
R77 Pull-down
R78 & R79 provide µC protection
R58 senses current
Connect +In and -In
as close as possible to R31
PMR25HZPFV1L00
R41 0.001R03K
LFB1_SNS+
U18
AD8418
+IN
-IN
NC
VS
OUT
VREF1
VREF2
LF_B1_SNS
LFB1SNS
220K
R24
R4 and R6 set Vref=1V
100K
R26
C44 0.1uF
Sense Resistor has 2.5x power rating <2s


LiFePO4 Bank 2 Charging
SP_OUT
D9
DFLS130L
LF-B2-CHG-IN
L4
56uH
22nF
C34
U16
LTC4121
INTVCC
BOOST
IN
SW
GND
MPPT
FREQ
CHGSNS
RUN
~FAULT
~CHRG
PROG
NTC
FBG
FB
BAT
VIA
LFB2_CHG
LF_B2_CHG
R62
100K
GND
+3V3
R60
470K
R61
470K
LF_B2_FAULTN
LF_B2_CHGN
R70 887K
R71
1.74M
R69 6.04K
R63
330K
R64
43K
10uF
C32
2.2uF
C33
C35
22uF
LIFE3
R67
287K
LF3_REF
LF3_REF
VIA
LIFEPO43
3.5V
R68
100K
1uF
C47
D5
SMBJ5343B
LIFEPO44
3.5V
R65
95
LF4_REF
LF4_REF
VIA
R66
100K
1uF
C48
F5
2016L500
F6
2016L500
LIFE3FUSEOUT
SW2
BTS50015-1TAD
VB
CNTRL
ISNS
OUT
GND
PAD
LF_B2
LF_B2
VIA
C32
10nF
4.7K
R82
LF_B2_OSNS
LFB2_OSNS
VIA
C38
0.1uF
R76
1K
4.7K
R81
LF_B2_OUTEN
VIA
LFB2_OUTEN
150nF
C36
R80
100K
Connect +In and -In
as close as possible to R31
R59
0.001R@3W
LFB2_SNS+
GND
U19
AD8418
+IN
-IN
NC
VS
OUT
VREF1
VREF2
GND
+3V3
LFB2SNS
VIA
LF_B2_SNS
+3V3
220K
R29
R4 and R6 set Vref=1V
100K
R30
0.1uF
C49