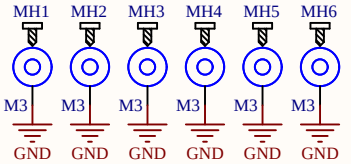
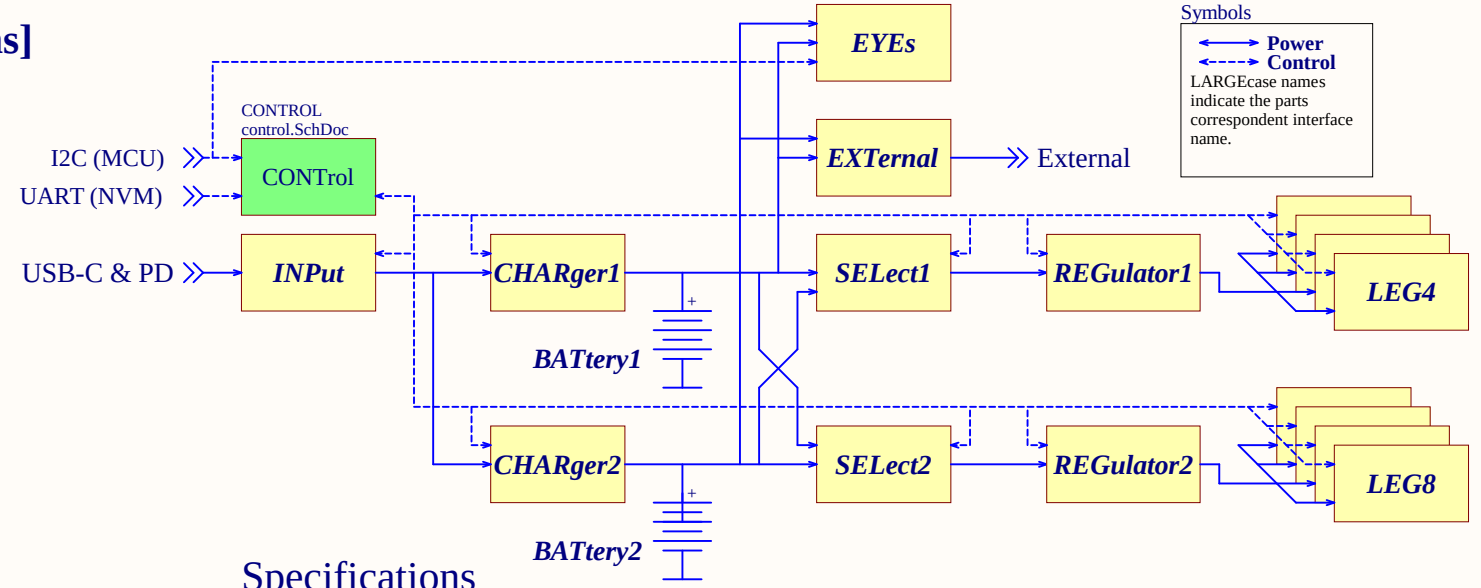


ASH Power

Variant: [No Variations]

Table of content



Introduction

This board manages power control and distribution for my Octapod.

The power board has the following responsibilites:
* Regulate servo voltage from 2 or 3S Li-ion battery packs.
* Measure voltage and current to servos.
* Supply the main board with power (not regulated).
* Provide soft-start functionality for servos.
* Control power on/off to servos.
* Protect batteries with UVLO and OVLO.
* Integrated charger using external USB-C supply.
* Provide an interface for both main board MCU(I2C) and NVM(serial-SCPI).

Specifications

* Serial interface
* I2C control address:
  - CONTrol: 0x70
  - EYEs: 0x48
* I2C slave addresses:
  - USB-PD: 0x28
  - Mux: 0x70 (1,2)
    - Charger: 0x6D
    - Leg-control: 0x60-0x63
    - Leg-isense: 0x70-0x73

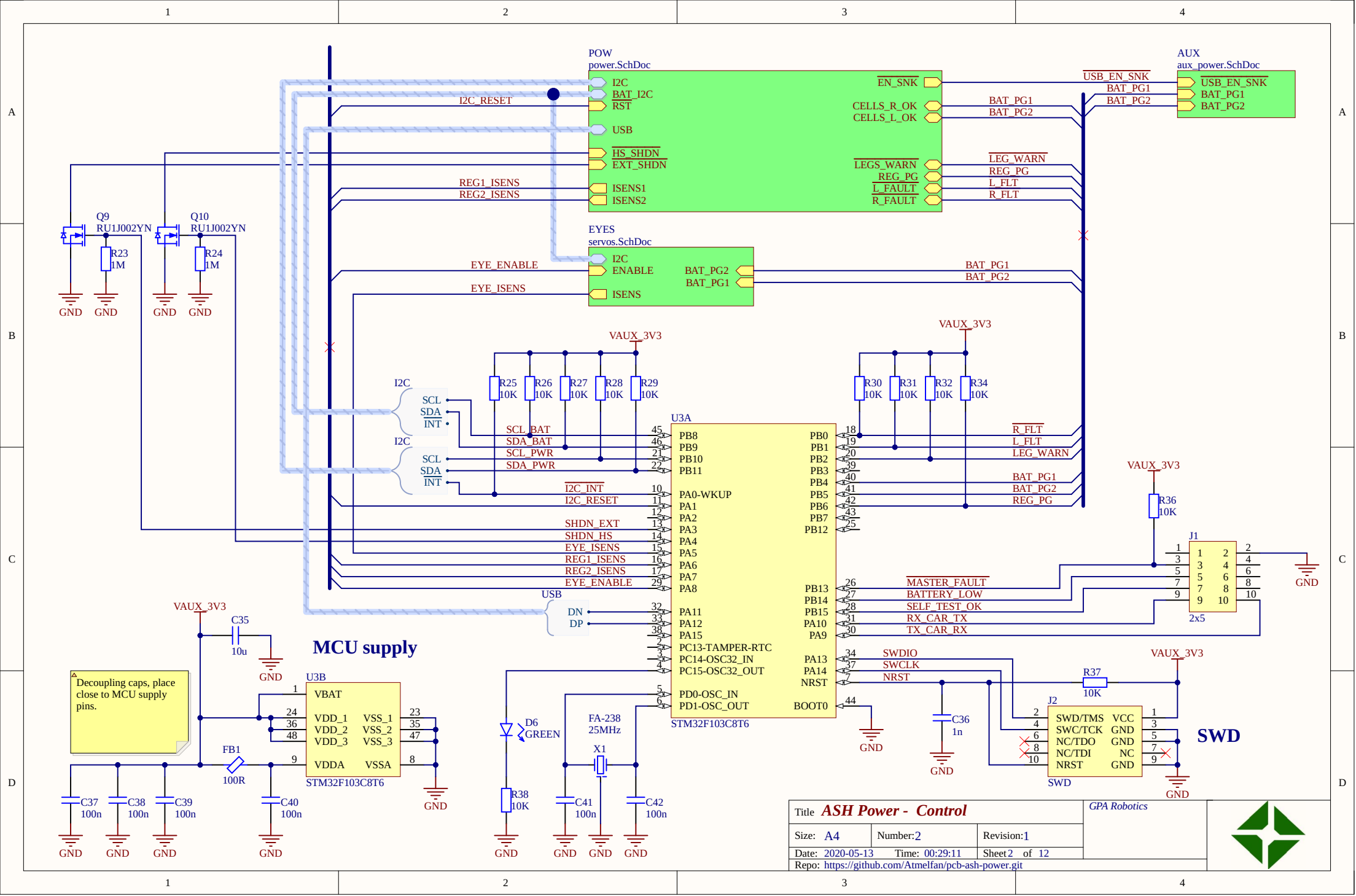
Carrier connector

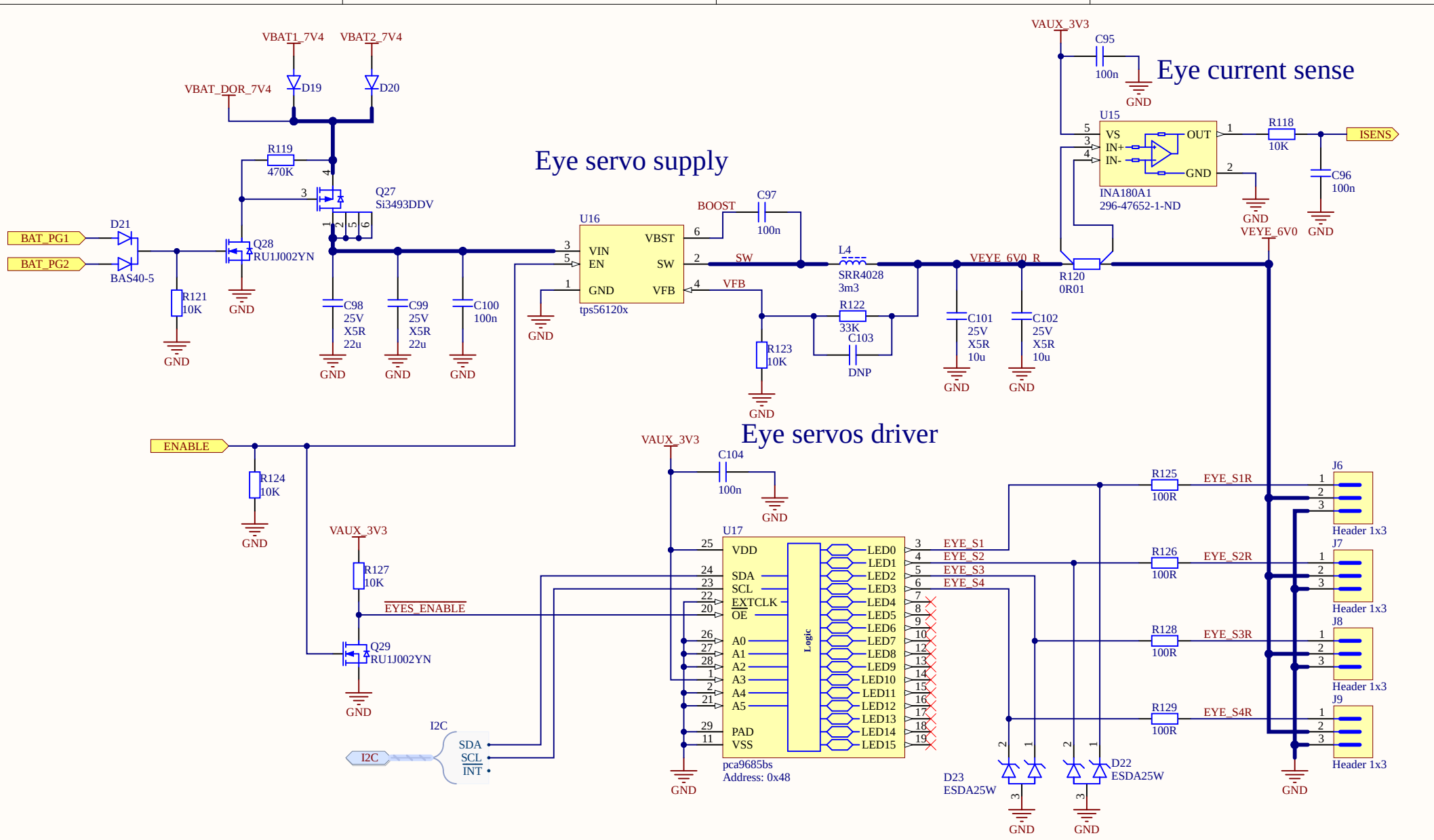
1 - NC
2 - GND
3 - \MASTER_FAULT
4 - NC
5 - \BATTERY_LOW
6 - NC
7 - SELF_TEST_OK
8 - NC
9 - RX (Carrier TX)
10 - TX (Carrier RX)

External connector

1 - SCL
2 - GND
3 - GND
4 - SDA
5 - VS
6 - VS

Title	ASH Power - Cover		GPA Robotics
Size: A4	Number: 1	Revision: 1	
Date: 2020-05-13	Time: 00:29:10	Sheet 1 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			


POW
power.SchDoc
I2C
BAT_I2C
RST
USB
HS_SHDN
EXT_SHDN
ISENS1
ISENS2
EN_SNK
CELLS_R_OK
CELLS_L_OK
LEGS_WARN
REG_PG
L_FAULT
R_FAULT
AUX
aux_power.SchDoc
USB_EN_SNK
BAT_PG1
BAT_PG2
I2C_RESET
REG1_ISENS
REG2_ISENS
EYES
servos.SchDoc
I2C
ENABLE
ISENS
EYE_ENABLE
EYE_ISENS
Q9
RU1J002YN
Q10
RU1J002YN
R23
1M
R24
1M
GND
VAUX_3V3
R25
10K
R26
10K
R27
10K
R28
10K
R29
10K
R30
10K
R31
10K
R32
10K
R34
10K
R36
10K
R37
10K
R38
10K
U3A
PB8
PB9
PB10
PB11
PA0-WKUP
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA11
PA12
PA15
PC13-TAMPER-RTC
PC14-OSC32_IN
PC15-OSC32_OUT
PD0-OSC_IN
PD1-OSC_OUT
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB12
PB13
PB14
PB15
PA10
PA9
PA13
PA14
NRST
BOOT0
STM32F103C8T6
SCL_BAT
SDA_BAT
SCL_PWR
SDA_PWR
I2C_INT
I2C_RESET
SHDN_EXT
SHDN_HS
EYE_ISENS
REG1_ISENS
REG2_ISENS
EYE_ENABLE
USB
DN
DP
R_FLT
L_FLT
LEG_WARN
BAT_PG1
BAT_PG2
REG_PG
MASTER_FAULT
BATTERY_LOW
SELF_TEST_OK
RX_CAR_TX
TX_CAR_RX
SWDIO
SWCLK
NRST
J1
2x5
J2
SWD/TMS
SWC/TCK
NC/TDO
NC/TDI
NRST
VCC
GND
NC
SWD
MCU supply
Decoupling caps, place close to MCU supply pins.
U3B
VBAT
VDD_1
VDD_2
VDD_3
VDDA
VSS_1
VSS_2
VSS_3
VSSA
STM32F103C8T6
FB1
100R
C35
10u
C36
1n
C37
100n
C38
100n
C39
100n
C40
100n
C41
100n
C42
100n
D6
GREEN
FA-238
25MHz
X1
Title ASH Power - Control
GPA Robotics
Size: A4
Number:2
Revision:1
Date: 2020-05-13
Time: 00:29:11
Sheet 2 of 12
Repo: https://github.com/Atmelfan/pcb-ash-power.git



Title	***ASH Power - Eye servos***		*GPA Robotics*
Size: A4	Number:3	Revision:1	
Date: 2020-05-13	Time: 00:29:11	Sheet 3 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			

Ext connector

External switch

EXT
ext_power.SchDoc
VBUS
EXT_SHDN
PWR_OK3
BAT1
BAT2
EXTERNAL
BAT1_OK
BAT2_OK

EXT_SHDN
VEXT_7V4

R130 220R
R131 220R
SDA
SCL
INT
I2C
BAT_I2C

J4
430450617
TAB
GND

D14
ESDA25W

USB-PD

USB
usbpd_input.SchDoc
VOUT
EN_SNK
PWR_OK3
USB
I2C
RST

EN_SNK
USB

USB sink disables charger OTG mode to prevent reverse current.

P2
XT60PT-M
TAB
VBAT1_7V4

Battery switches

HS_R
hs_switch.SchDoc
PRIMARY
SECONDARY
VOUT
SHDN
SEC_OK
PRI_FAULT
SEC_FAULT
CELLS_OK

REG_VIN_R
R_FAULT
CELLS_R_OK
CELLS_L_OK

HS_L
hs_switch.SchDoc
SEC_OK
SHDN
CELLS_OK
PRI_FAULT
SEC_FAULT
SECONDARY
PRIMARY
VOUT

L_FAULT
REG_VIN_L

REG_R
gan_buck.SchDoc
VIN
VOUT
ISENS
PG

REG_L
gan_buck.SchDoc
PG
ISENS
VIN
VOUT

ISENS2
ISENS1

Legs

LEG_R
leg_group.SchDoc
VIN
I2C
WARN

LEG_L
leg_group.SchDoc
WARN
I2C
VIN

LEGS_WARN
REG_PG

P3
XT60PT-M
TAB
VBAT2_7V4

HS_SHDN
R54
1M

The highside switches controls the power to the servos. Each side is independently controlled.

The switch can use both batteries but will prioritize the battery on the same side as itself. E.g. HS_R will use BAT_R unless it is in UVLO/OVLO where it'll use BAT_L instead (assuming BAT_L is OK).

I2C multiplexer

VAUX_3V3
C59
100n
U9
tca9543a
Address: 0x70
VCC
SCL
SDA
INT
RESET
A0
A1
Logic
SD0
SC0
INT0
SD1
SC1
INT1
GND

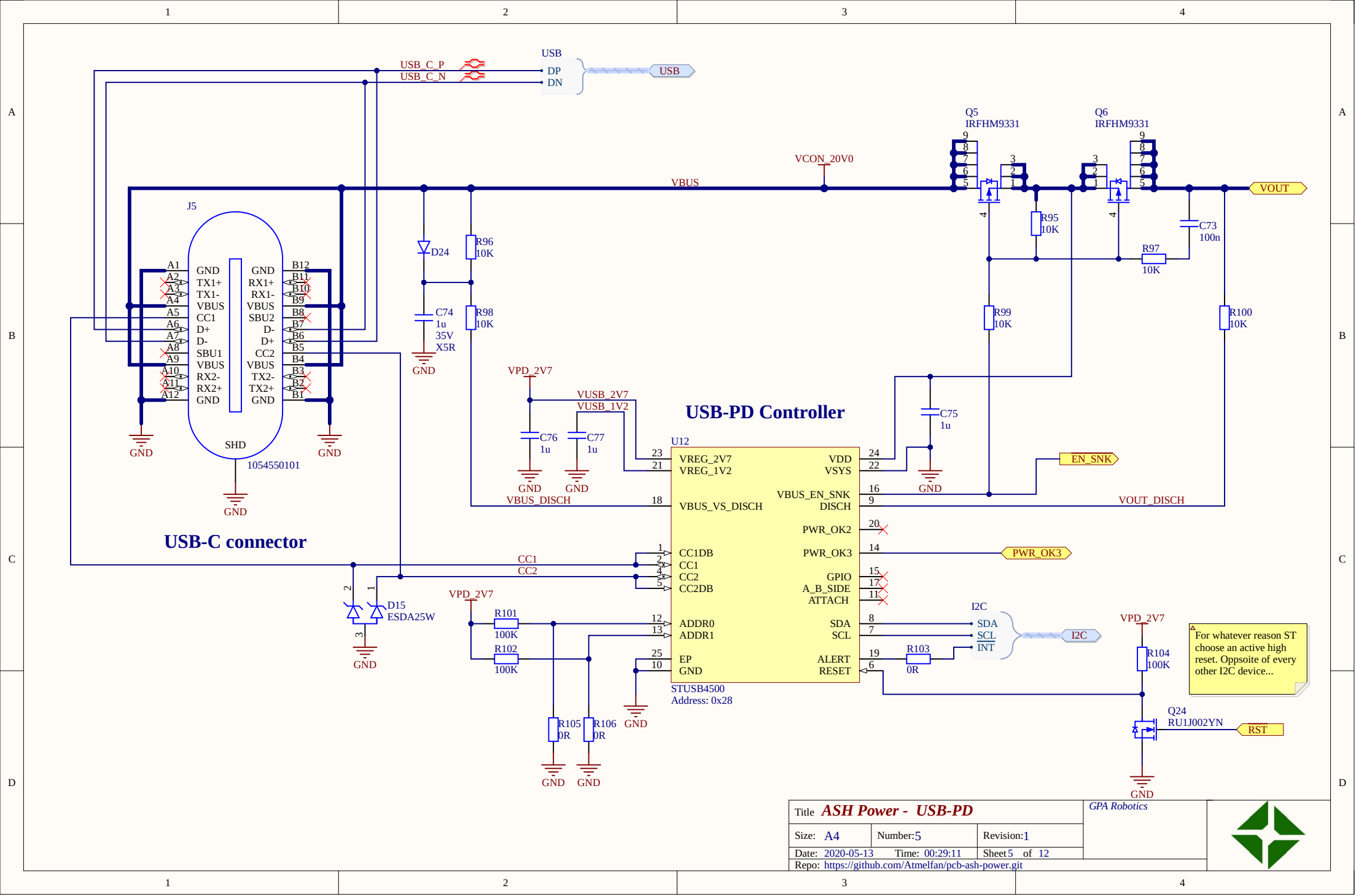
R74 10K
R75 10K
R76 10K
R77 10K

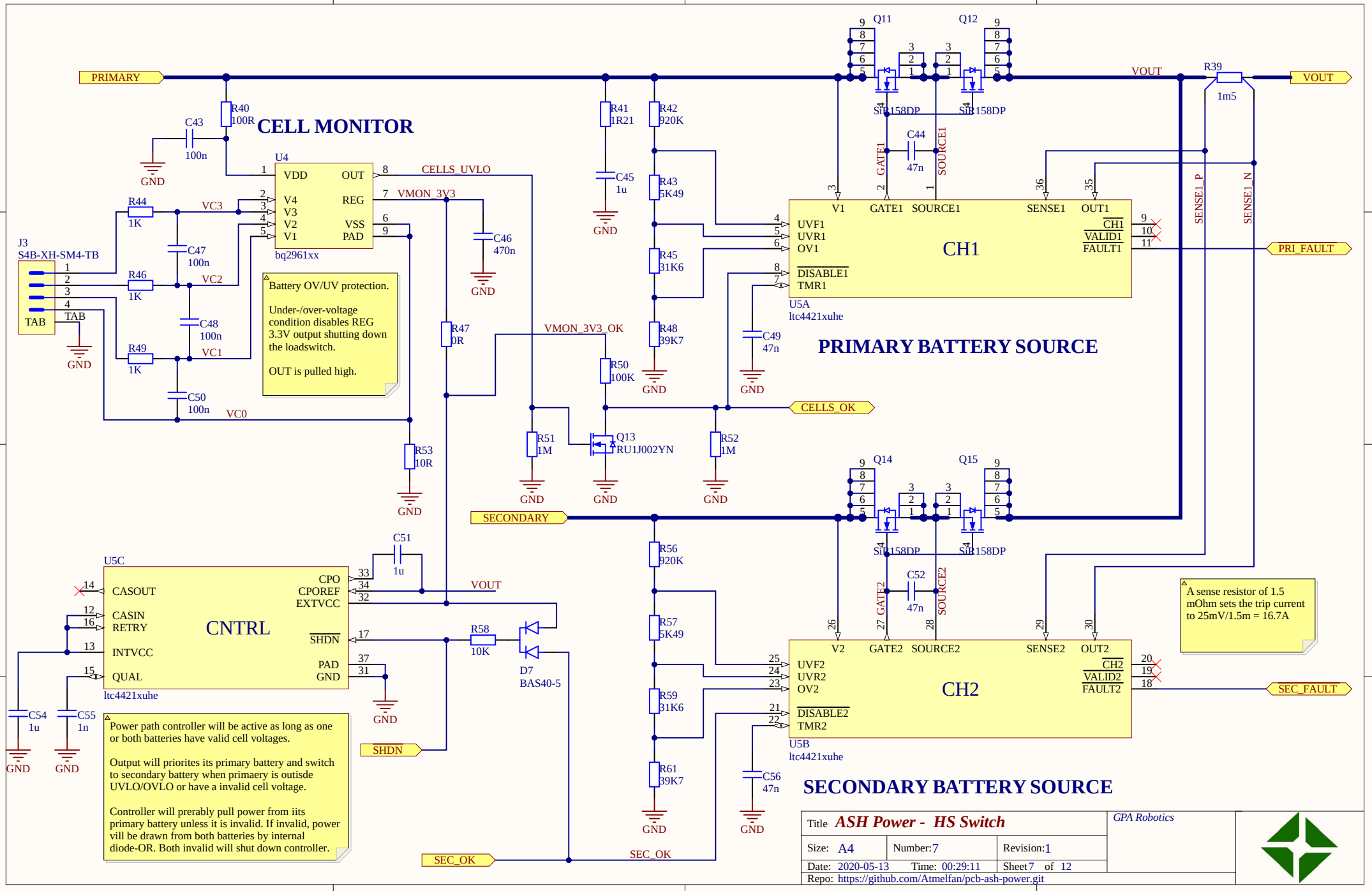
SDA_R
SCL_R
INT_R
SDA_L
SCL_L
INT_L

I2C
RST
R_I2C
L_I2C

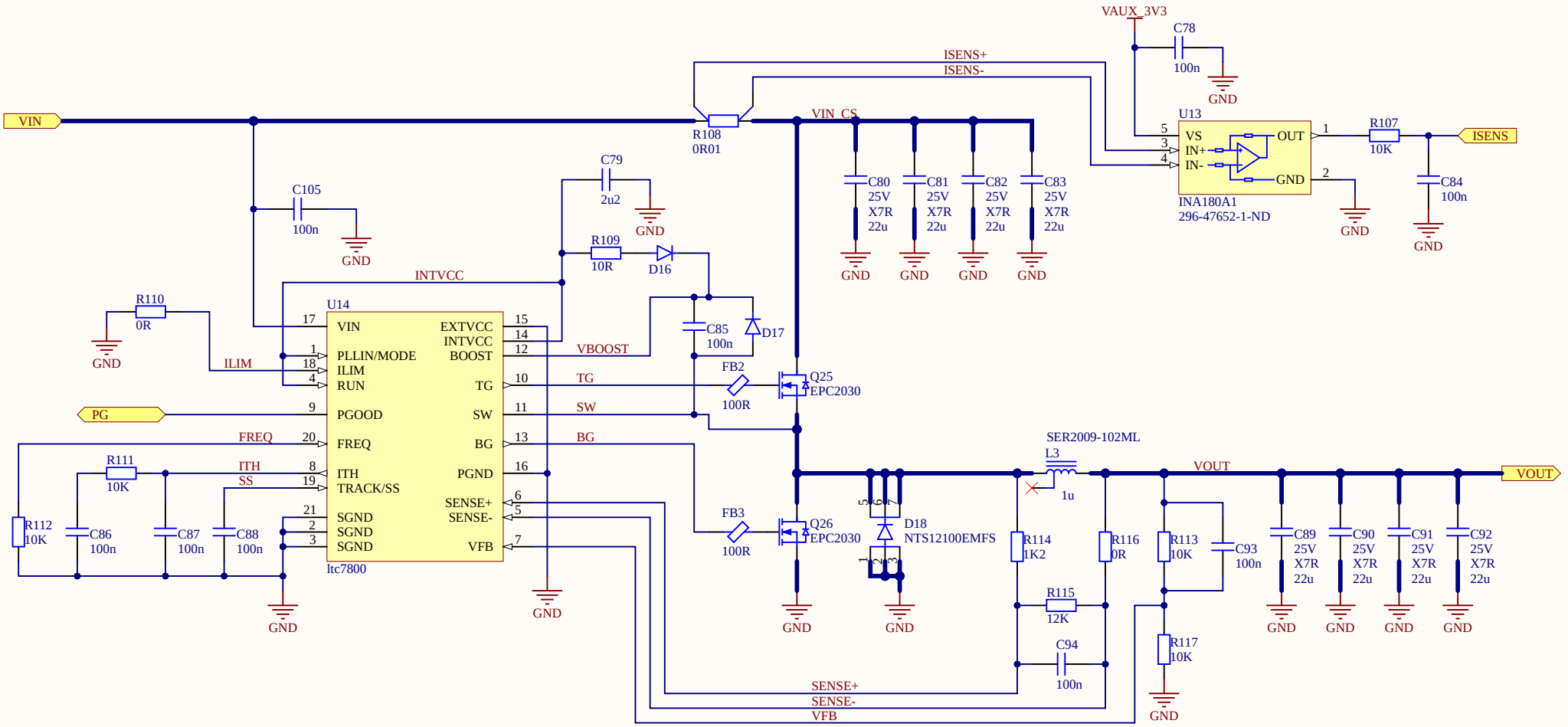
I2C multiplexer splits the I2C bus in two domains, left and right.

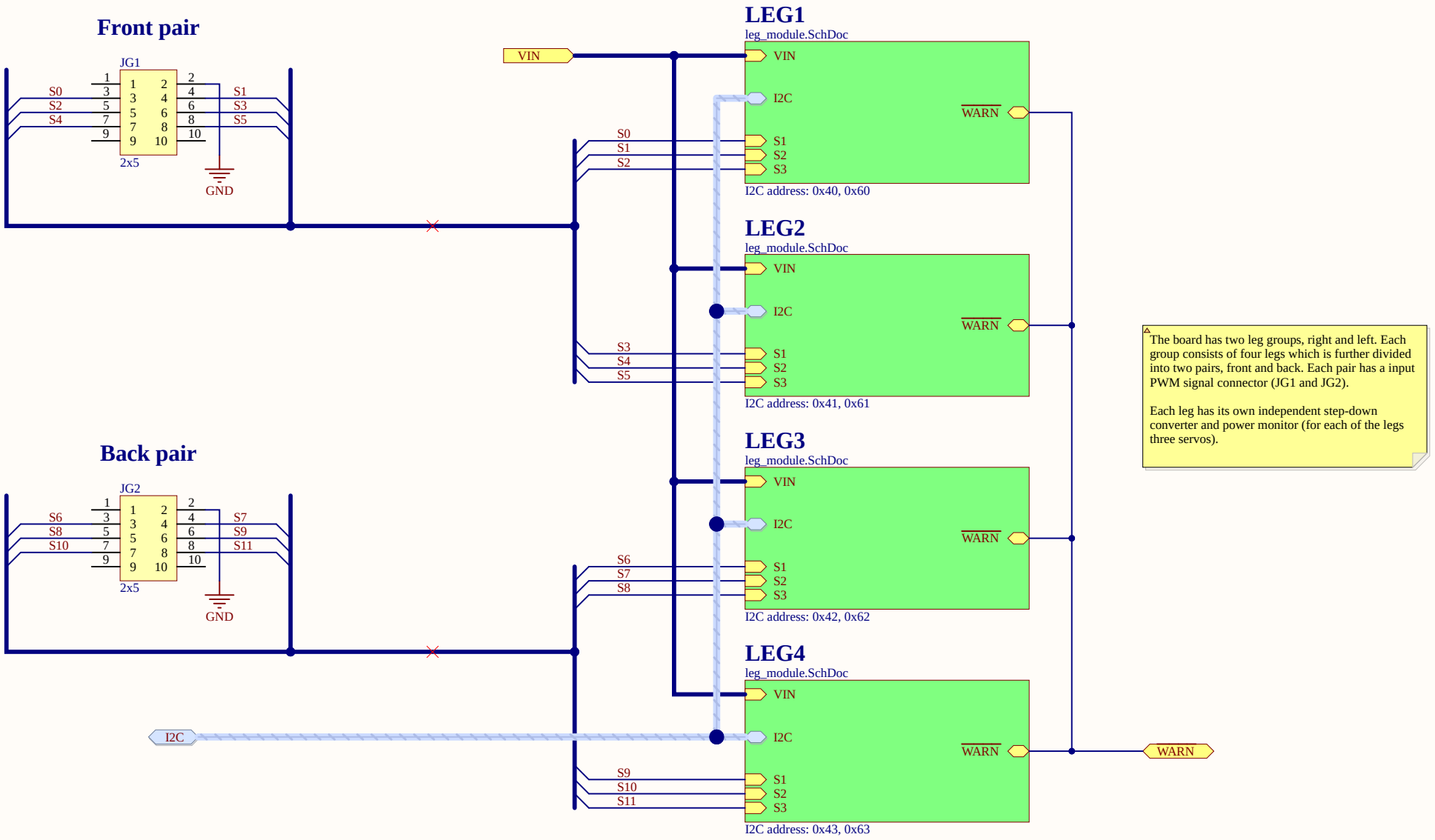
Title	***ASH Power - Power***		*GPA Robotics*
Size: A3	Number:4	Revision:1	
Date: 2020-05-13	Time: 00:29:11	Sheet 4 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			


USB
USB_C_P
USB_C_N
DP
DN
USB
Q5
IRFHM9331
Q6
IRFHM9331
VCON_20V0
VBUS
VOUT
J5
USB-C connector
SHD
1054550101
GND
D24
R96
10K
C74
1u
35V
X5R
R98
10K
R95
10K
R97
10K
C73
100n
R99
10K
R100
10K
VPD_2V7
VUSB_2V7
VUSB_1V2
C76
1u
C77
1u
C75
1u
USB-PD Controller
U12
VREG_2V7
VREG_1V2
VDD
VSYS
VBUS_EN_SNK
VBUS_VS_DISCH
DISCH
PWR_OK2
PWR_OK3
CC1DB
CC1
CC2
CC2DB
GPIO
A_B_SIDE
ATTACH
ADDR0
ADDR1
SDA
SCL
EP
GND
ALERT
RESET
EN_SNK
VOUT_DISCH
PWR_OK3
I2C
SDA
SCL
INT
STUSB4500
Address: 0x28
CC1
CC2
D15
ESDA25W
R101
100K
R102
100K
R103
0R
R104
100K
R105
0R
R106
0R
Q24
RU1J002YN
RST
For whatever reason ST choose an active high reset. Oppsoite of every other I2C device...
Title ASH Power - USB-PD
GPA Robotics
Size: A4
Number:5
Revision:1
Date: 2020-05-13
Time: 00:29:11
Sheet 5 of 12
Repo: https://github.com/Atmelfan/pcb-ash-power.git

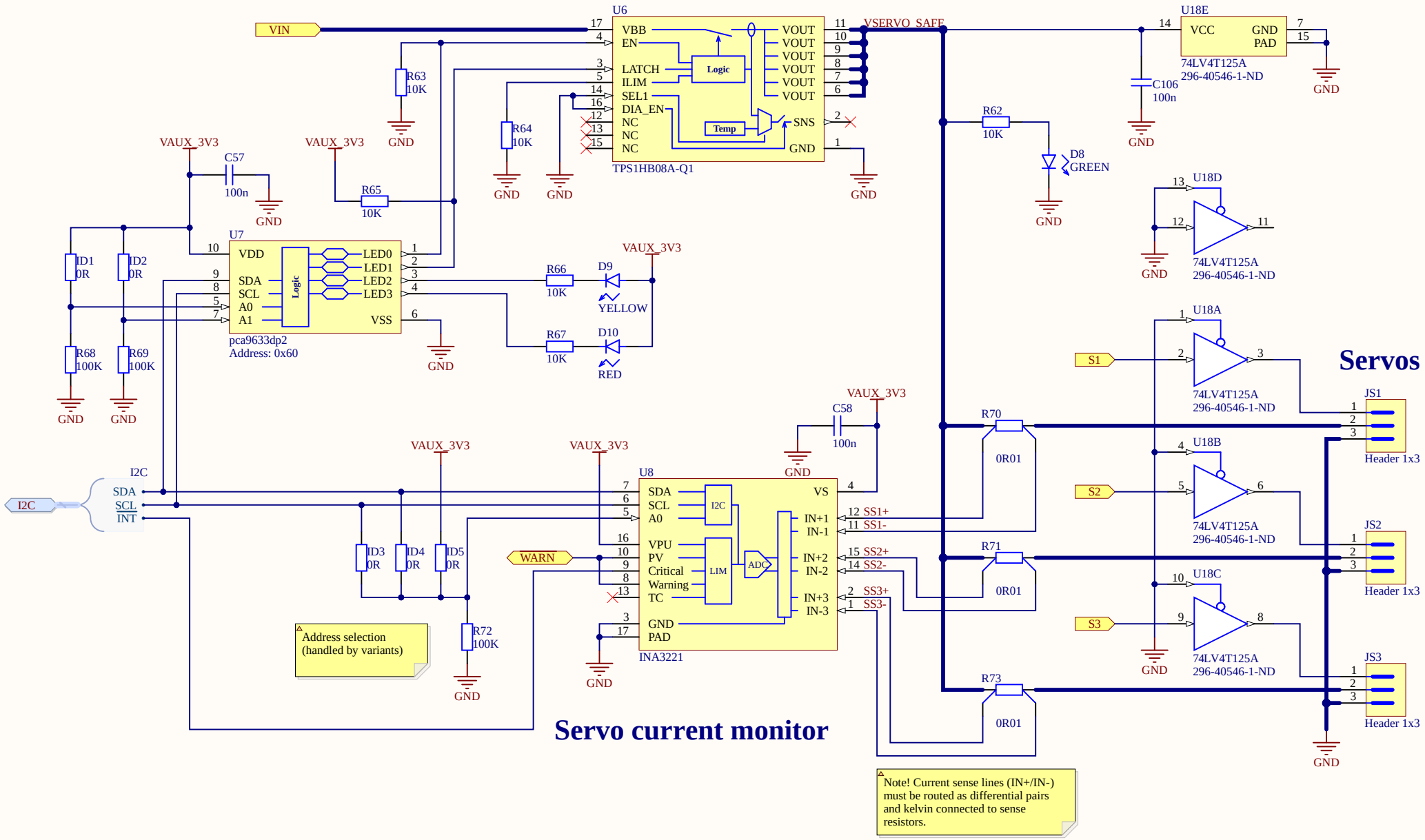


Title	*ASH Power - HS Switch*		*GPA Robotics*
Size: A4	Number:7	Revision:1	
Date: 2020-05-13	Time: 00:29:11	Sheet 7 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			


VAUX_3V3
C78
100n
GND
ISENS+
ISENS-
VIN
R108
0R01
VIN_CS
U13
VS
IN+
IN-
OUT
GND
INA180A1
296-47652-1-ND
R107
10K
ISENS
C84
100n
C80
25V
X7R
22u
C81
C82
C83
C105
C79
2u2
R109
10R
D16
INTVCC
R110
0R
U14
VIN
PLLIN/MODE
ILIM
RUN
PGOOD
FREQ
ITH
TRACK/SS
SGND
EXTVCC
INTVCC
BOOST
TG
SW
BG
PGND
SENSE+
SENSE-
VFB
ltc7800
VBOOST
C85
100n
D17
FB2
100R
Q25
EPC2030
PG
FREQ
ILIM
SS
R111
10K
R112
10K
C86
C87
C88
FB3
Q26
D18
NTS12100EMFS
SER2009-102ML
L3
1u
VOUT
R114
1K2
R116
0R
R113
10K
C93
R115
12K
C94
R117
C89
C90
C91
C92
SENSE+
SENSE-
VFB
Title ASH Power - GaN Step-down
GPA Robotics
Size: A4
Number:8
Revision:1
Date: 2020-05-13
Time: 00:29:11
Sheet 8 of 12
Repo: https://github.com/Atmelfan/pcb-ash-power.git

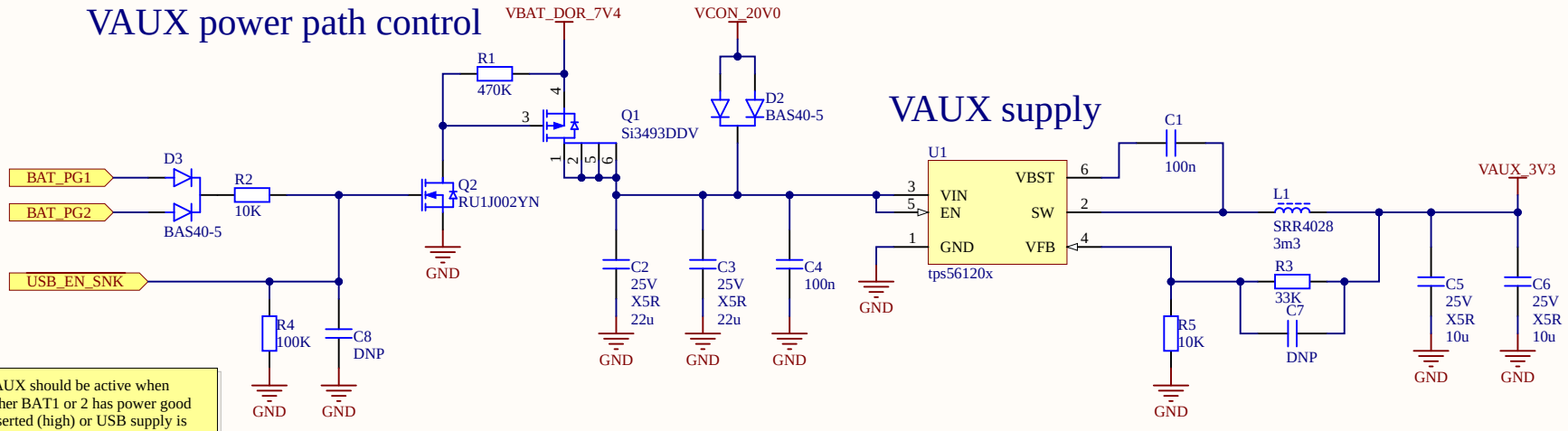


Title	***ASH Power - Leg group***		*GPA Robotics*
Size: A4	Number:9	Revision:1	
Date: 2020-05-13	Time: 00:29:11	Sheet 9 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			



Title	*ASH Power - Leg module*		*GPA Robotics*
Size: A4	Number: 10	Revision: 1	
Date: 2020-05-13	Time: 00:29:11	Sheet 10 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			

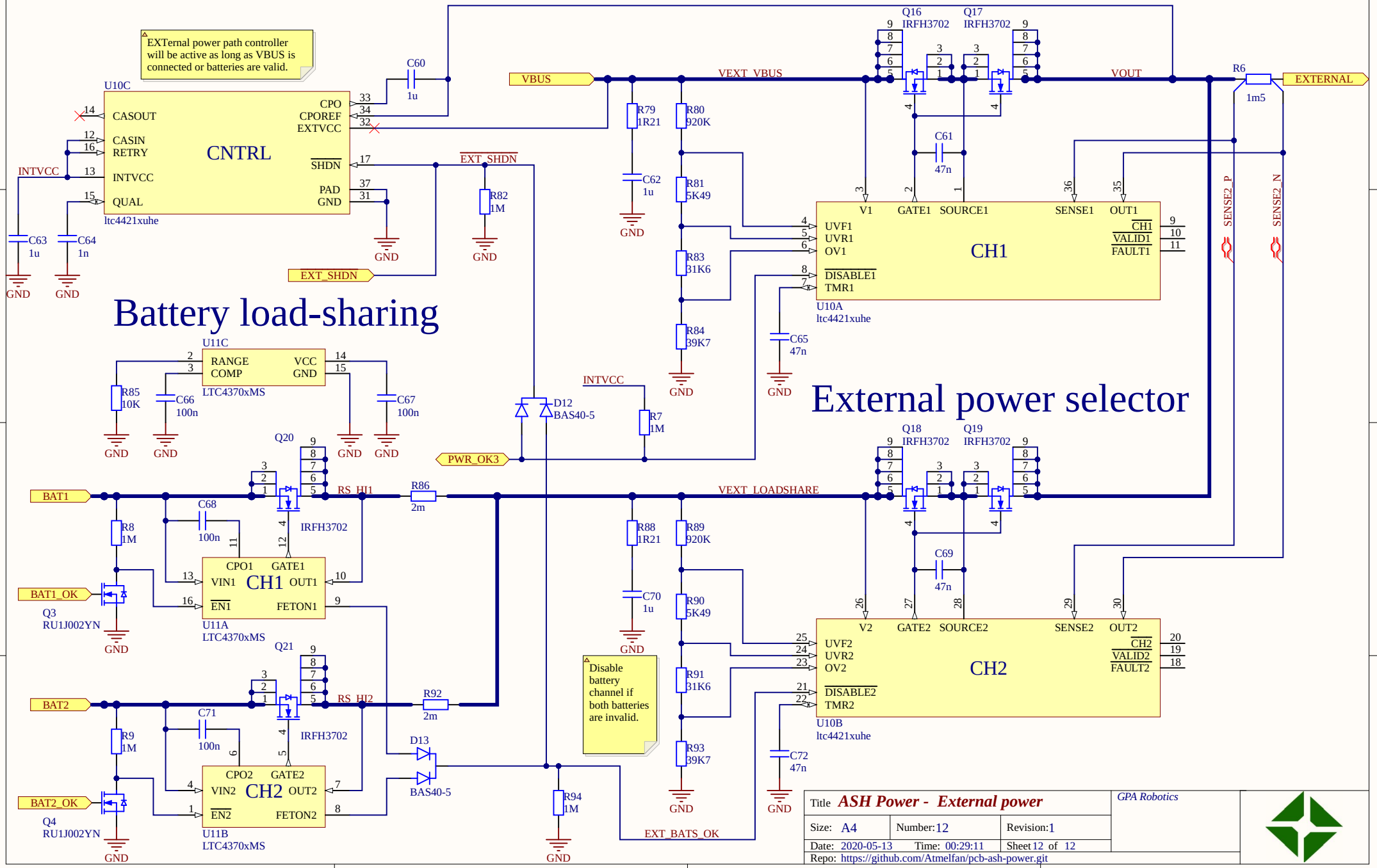
VAUX supplies the control circuitry of the power board.



VAUX should be active when either BAT1 or 2 has power good asserted (high) or USB supply is available.

If USB supply is available (5-20V) batteries should not be used for VAUX (even if VBATn > VBUS).

Title	***ASH Power - AUX supply***		*GPA Robotics*
Size: A4	Number: 11	Revision: 1	
Date: 2020-05-13	Time: 00:29:11	Sheet 11 of 12	
Repo: https://github.com/Atmelfan/pcb-ash-power.git			


EXTernal power path controller will be active as long as VBUS is connected or batteries are valid.
U10C
CNTRL
CASOUT
CASIN
RETRY
INTVCC
QUAL
CPO
CPOREF
EXTVCC
SHDN
PAD
GND
ltc4421xuhe
C60
1u
C63
1u
C64
1n
R82
1M
EXT_SHDN
Battery load-sharing
U11C
LTC4370xMS
RANGE
COMP
VCC
GND
R85
10K
C66
100n
C67
100n
D12
BAS40-5
R7
1M
PWR_OK3
Q20
IRFH3702
BAT1
RS_HI1
R86
2m
C68
100n
R8
1M
BAT1_OK
Q3
RU1J002YN
U11A
CPO1
GATE1
VIN1
CH1
OUT1
EN1
FETON1
Q21
IRFH3702
BAT2
RS_HI2
R92
2m
C71
100n
R9
1M
BAT2_OK
Q4
RU1J002YN
U11B
CPO2
GATE2
VIN2
CH2
OUT2
EN2
FETON2
D13
BAS40-5
R94
1M
Disable battery channel if both batteries are invalid.
EXT_BATS_OK
External power selector
VBUS
VEXT_VBUS
VOUT
R6
1m5
EXTERNAL
Q16
IRFH3702
Q17
IRFH3702
R79
1R21
R80
920K
C62
1u
R81
5K49
R83
31K6
R84
39K7
C61
47n
C65
47n
U10A
ltc4421xuhe
V1
GATE1
SOURCE1
SENSE1
OUT1
UVF1
UVR1
OV1
DISABLE1
TMR1
CH1
VALID1
FAULT1
SENSE2_P
SENSE2_N
Q18
IRFH3702
Q19
IRFH3702
VEXT_LOADSHARE
R88
1R21
R89
920K
C70
1u
R90
5K49
R91
31K6
R93
39K7
C69
47n
C72
47n
U10B
ltc4421xuhe
V2
GATE2
SOURCE2
SENSE2
OUT2
UVF2
UVR2
OV2
DISABLE2
TMR2
CH2
VALID2
FAULT2
GND
INTVCC
Title ASH Power - External power
Size: A4
Number: 12
Revision: 1
Date: 2020-05-13
Time: 00:29:11
Sheet 12 of 12
Repo: https://github.com/Atmelfan/pcb-ash-power.git
GPA Robotics