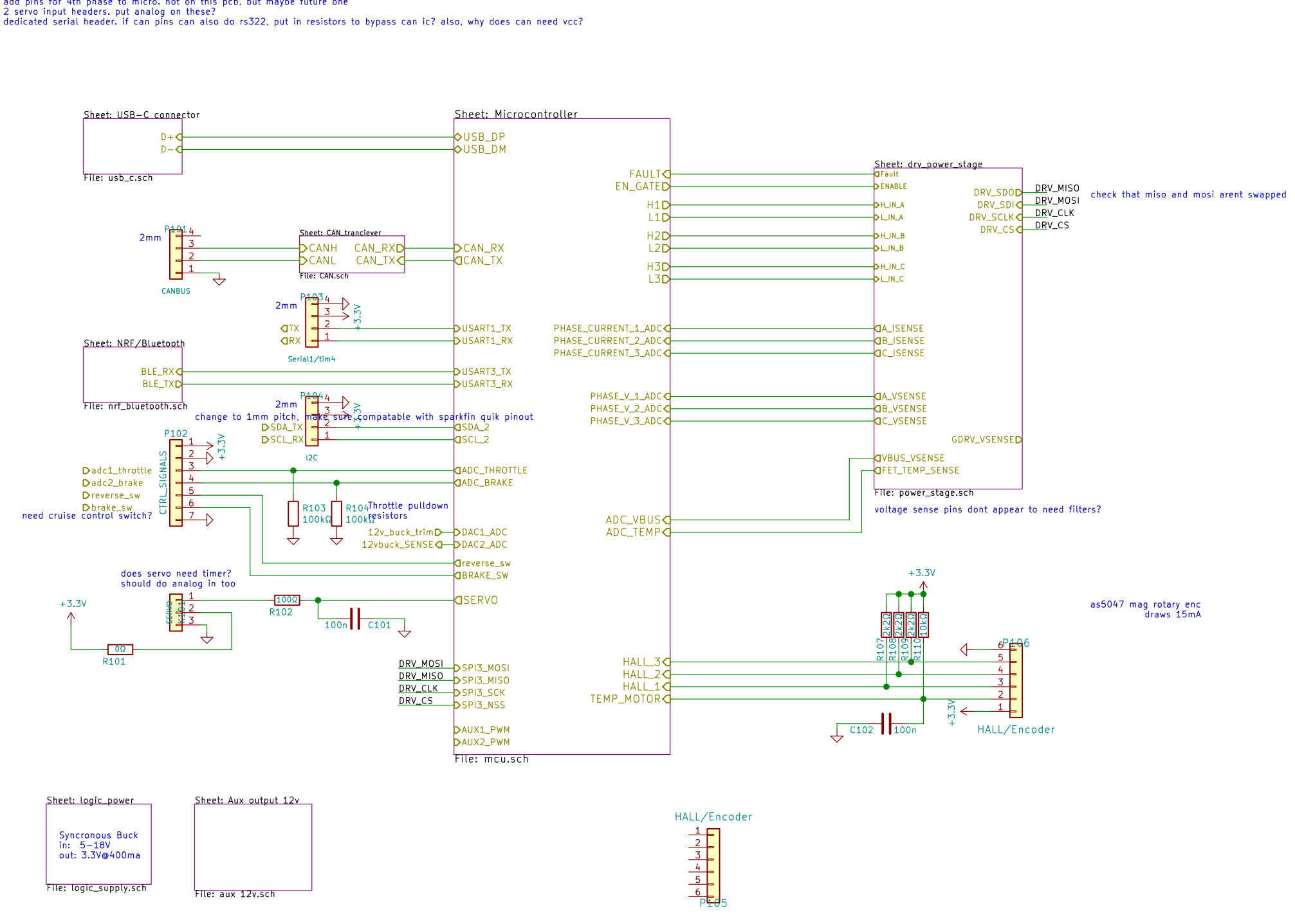
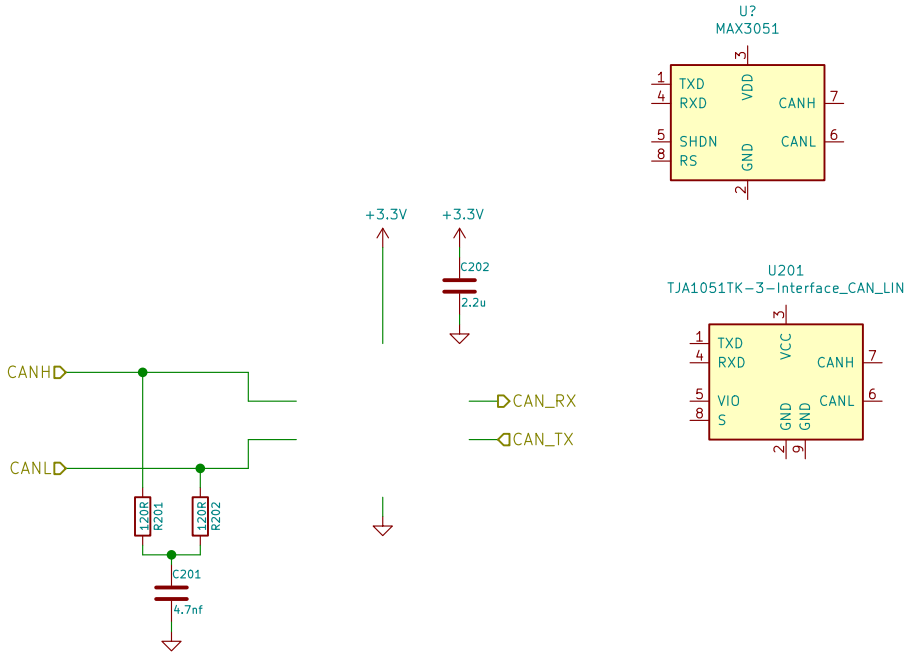
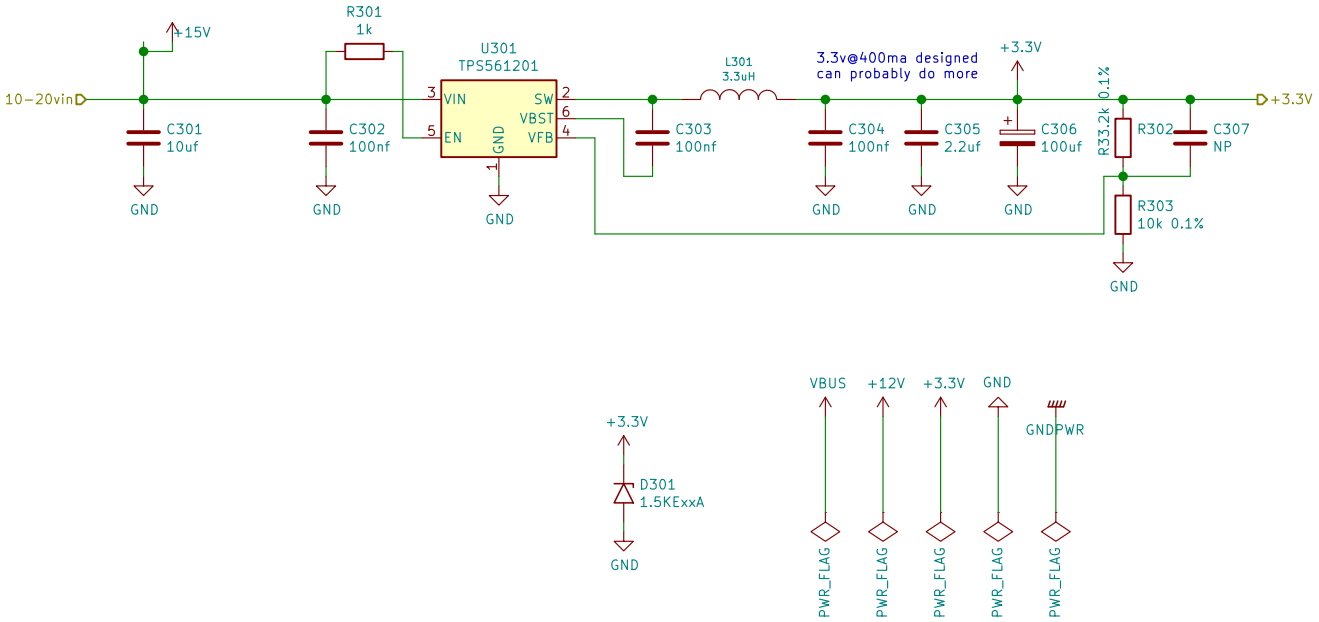

add pins for 4th phase to micro. not on this pcb, but maybe future one
2 servo input headers. put analog on these?
dedicated serial header. if can pins can also do rs322, put in resistors to bypass can ic? also, why does can need vcc?
Sheet: USB-C connector
D+
D-
File: usb_c.sch
Sheet: Microcontroller
USB_DP
USB_DM
Sheet: CAN tranciever
CANH
CANL
CAN_RX
CAN_TX
File: CAN.sch
P101
2mm
CANBUS
P103
Serial1/tim4
TX
RX
USART1_TX
USART1_RX
+3.3V
Sheet: NRF/Bluetooth
BLE_RX
BLE_TX
USART3_TX
USART3_RX
File: nrf_bluetooth.sch
P104
I2C
SDA_TX
SCL_RX
SDA_2
SCL_2
change to 1mm pitch, make sure compatable with sparkfin quik pinout
P102
CTRL_SIGNALS
adc1_throttle
adc2_brake
reverse_sw
brake_sw
need cruise control switch?
ADC_THROTTLE
ADC_BRAKE
R103
100kΩ
R104
100kΩ
Throttle pulldown resistors
12v_buck_trim
12vbuck_SENSE
DAC1_ADC
DAC2_ADC
reverse_sw
BRAKE_SW
does servo need timer?
should do analog in too
SERVO
R102
100Ω
100n
C101
R101
0Ω
DRV_MOSI
DRV_MISO
DRV_CLK
DRV_CS
SPI3_MOSI
SPI3_MISO
SPI3_SCK
SPI3_NSS
AUX1_PWM
AUX2_PWM
File: mcu.sch
FAULT
EN_GATE
H1
L1
H2
L2
H3
L3
PHASE_CURRENT_1_ADC
PHASE_CURRENT_2_ADC
PHASE_CURRENT_3_ADC
PHASE_V_1_ADC
PHASE_V_2_ADC
PHASE_V_3_ADC
ADC_VBUS
ADC_TEMP
HALL_3
HALL_2
HALL_1
TEMP_MOTOR
Sheet: drv_power_stage
Fault
ENABLE
H_IN_A
L_IN_A
H_IN_B
L_IN_B
H_IN_C
L_IN_C
A_ISENSE
B_ISENSE
C_ISENSE
A_VSENSE
B_VSENSE
C_VSENSE
GDRV_VSENSE
VBUS_VSENSE
FET_TEMP_SENSE
DRV_SDO
DRV_SDI
DRV_SCLK
DRV_CS
DRV_MISO
DRV_MOSI
DRV_CLK
DRV_CS
check that miso and mosi arent swapped
File: power_stage.sch
voltage sense pins dont appear to need filters?
+3.3V
R107
2k2Ω
R108
2k2Ω
R109
2k2Ω
R110
10kΩ
P106
HALL/Encoder
C102
100n
as5047 mag rotary enc
draws 15mA
Sheet: logic_power
Syncronous Buck
in: 5-18V
out: 3.3V@400ma
File: logic_supply.sch
Sheet: Aux output 12v
File: aux 12v.sch
HALL/Encoder
P105


U?
MAX3051
TXD
RXD
SHDN
RS
VDD
GND
CANH
CANL
+3.3V
+3.3V
C202
2.2u
U201
TJA1051TK-3-Interface_CAN_LIN
TXD
RXD
VIO
S
VCC
GND
GND
CANH
CANL
CANH
CANL
CAN_RX
CAN_TX
R201
120R
R202
120R
C201
4.7nf


10-20vin
+15V
C301
10uf
GND
R301
1k
C302
100nf
GND
U301
TPS561201
3
VIN
5
EN
GND
1
GND
SW
2
VBST
6
VFB
4
C303
100nf
L301
3.3uH
3.3v@400ma designed
can probably do more
C304
100nf
GND
C305
2.2uf
GND
+3.3V
C306
100uf
GND
R33.2k 0.1%
R302
C307
NP
+3.3V
R303
10k 0.1%
GND
+3.3V
D301
1.5KExxA
GND
VBUS
+12V
+3.3V
GND
GNDPWR
PWR_FLAG
PWR_FLAG
PWR_FLAG
PWR_FLAG
PWR_FLAG

Q402
Q_PNP_BCE

+3.3V
R402
10kΩ
Fault
ENABLE
H_IN_A
L_IN_A
H_IN_B
L_IN_B
H_IN_C
L_IN_C
+3.3V
R401
1kOhm
why is this r needed?
DRV_SDO
DRV_SDI
DRV_SCLK
DRV_CS
GND
make agnd plane that runs
under all analog current signals
also kelvin connect 3.3v ref at mcu
A_ISENSE
B_ISENSE
C_ISENSE
+3.3V
3.3_IREF
C406
0.1uF
Net-Tie_2
NT403
GNDA
Net-Tie_2
NT401
GNDA
GND
Net-Tie_2
NT402
GNDD
GNDPWR
can this be changed to
100nf to reduce bom #?
C407
0.047uF
+15V
C401
10uF
C403
0.1uF
GNDD
GND
C408
1uF
vgls
GNDD
C409
1uF
dvdd
GND
GNDPWR
+BATT
C424
1uF
100V
C425
1uF
100V
C404
0.1uF
GND
GND
GND
BK_VIN
batt_pwr_ctl
R403
560kΩ
BK_RT_SD
BK_VCC
C416
0.1uF
C405
0.47uF
GND
GND
GND
jp perminantly enables power.
power switch will not work
+BATT
JP401
pwr_ctl_byp
R418
1M
pwr_ctl_g
Q401
Q_PNP_BCE
R419
500k
J406
Conn_01x03
switch
pwr_ctl
sw_led
R420
100
GNDD
+15V
batt_pwr_ctl
possibly change c502 to 2x 0603
or same as hv filter cap (1.0-2.2uf) 1206 package
and place on top if 1206

U401
DRV8353RSRGZT

28	FAULT_N	VCP	7
33	ENABLE	VDRAIN	6
34	INHA	GHA	8
35	INLA	SHA	9
36	INHB	GLA	10
37	INLB	SPA	11
38	INHC	SNA	12
39	INLC	GHB	17
29	MODE_SDO	SHB	16
30	IDRIVE_SDI	GLB	15
31	VDS_SCLK	SPB	14
32	NC_SCS_N	SNB	13
41	DGND	GHC	18
25	SOA	SHC	19
24	SOB	GLC	20
23	SOC	SPC	21
26	VREF	SNC	22
27	AGND		
4	CPH		
3	CPL		
5	VM		
2	VGLS		
10	DVDD		
43	VIN	BST	45
42	nRT_SD	SW	42
44	VCC		
49	PAD	FB	48
1	PGND	RCL	46

buck vin stby ic =120ua
LM5008A buck

+BATT
NT404
Net-Tie_2
vdrain must be kelvin connected to mosfet drain for
proper shoothrough overcurrent detection
C411
1uF
vcp
vdrain
vdrain stby ic < 40ua
diode footprint needs to be updated. can likely be put on bottonm of pcb
BK_BST_C
C410
0.01uF
BK_SW
L401
390uH
BK_VOUT_RIPP
D401
DFLS1100-7
GNDD
15v_FB
C412
18nF
R405
5.1kΩ
R406
1.0kΩ
R407
910mΩ
+15V
C413
10uF
C402
10uF
GNDD
GNDD
GNDD
GDRV_VSENSE
buck_rcl
R404
200kΩ
GNDD

Sheet: power_phase_A
H_GATE
H_SWITCH
L_GATE
PR_SENSE
NR_SENSE
PHASE_OUT
File: power_phase.sch

Sheet: power_phase_B
H_GATE
H_SWITCH
L_GATE
PR_SENSE
NR_SENSE
PHASE_OUT
File: power_phase.sch

Sheet: power_phase_C
H_GATE
H_SWITCH
L_GATE
PR_SENSE
NR_SENSE
PHASE_OUT
File: power_phase.sch

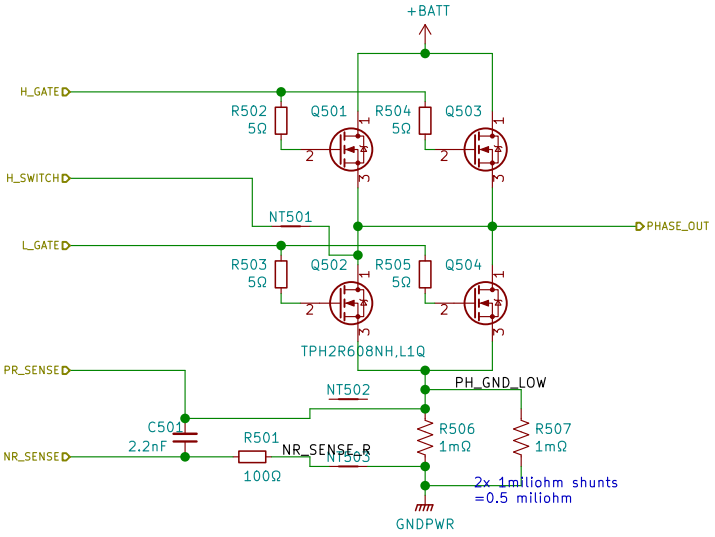
PHASE_A
J403
A
PHASE_B
J404
B
PHASE_C
J405
C

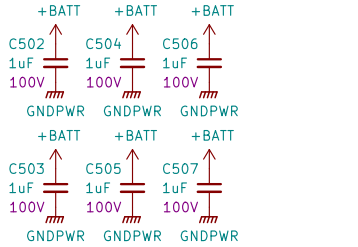
+BATT
C417
56uF
C419
56uF
C421
56uF
extra through hole caps to allow
smd or pth cap placement
GNDPWR
+BATT
C414
560uF
C418
20uF
80v
C420
20uF
80v
C422
20uF
80v
J401
+Vbat
J402
Gnd
batt vin pads spaced for
xt60 or 12-8awg wires
GNDPWR
try out a single alu solid polymer cap?

R408
47kΩ
A_VSENSE
R409
2.2kΩ
R410
47kΩ
B_VSENSE
R411
2.2kΩ
R412
47kΩ
C_VSENSE
R413
2.2kΩ
+BATT
R414
47kΩ
VBUS_VSENSE
R415
2.2kΩ
+3.3V
R416
10kΩ
FET_TEMP_SENSE
C423
100n
R417
NTC 10kΩ
place near low side fets
GNDA
The temp resistor ladder
is flipped from the vesc official hw
beacuse I do not want my 3.3v rail
anywhere near 48+v
will need to invert adc reading

Mosfet replacements:
TPW1R306PL, 60v, 1.29 mΩ, top cool
TPH2R608NH, 75v, 2.60mΩ, bottom cool
TPW2R508NH, 75v, 2.50 mΩ, top cool
TPW4R50ANH, 100v, 3.7 mΩ, top cool

Gain: (recalcualte)
0.00015 * 20v/v = 3mv/A
+−1.6v / 0.003 = 533A
see google spreadsheet





place caps as close to fets as possible.
can be replaced with 2.2uf caps if needed

kelvin connect shb_x to bottom fet drain to try out fet r current sense.
put i sense filter resistor on snc_x to be able to disconnect it and connecto to fet as well.

Mosfet replacements:
TPW1R306PL, 60v, 1.29 mΩ, top cool
TPH2R608NH, 75v, 2.60mΩ, bottom cool
TPW2R508NH, 75v, 2.50 mΩ, top cool
TPW4R50ANH, 100v, 3.7 mΩ, top cool

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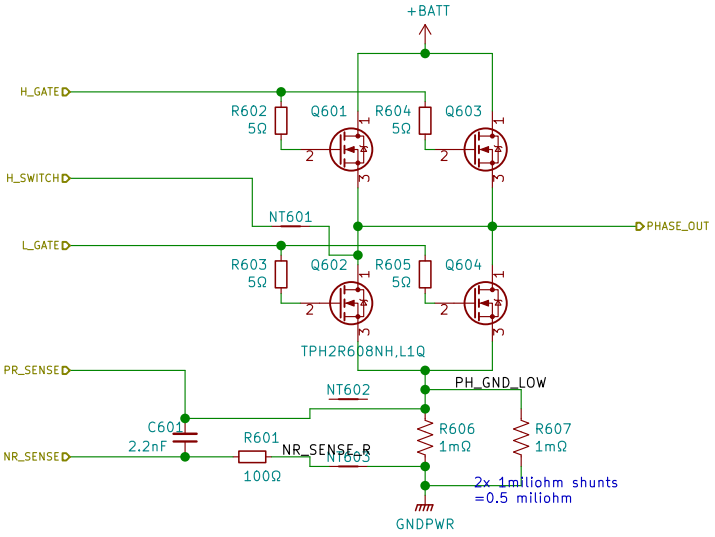
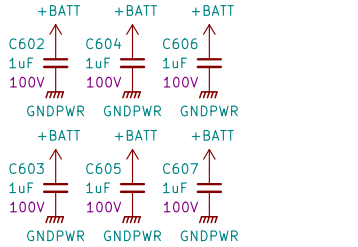
see google spreadsheet





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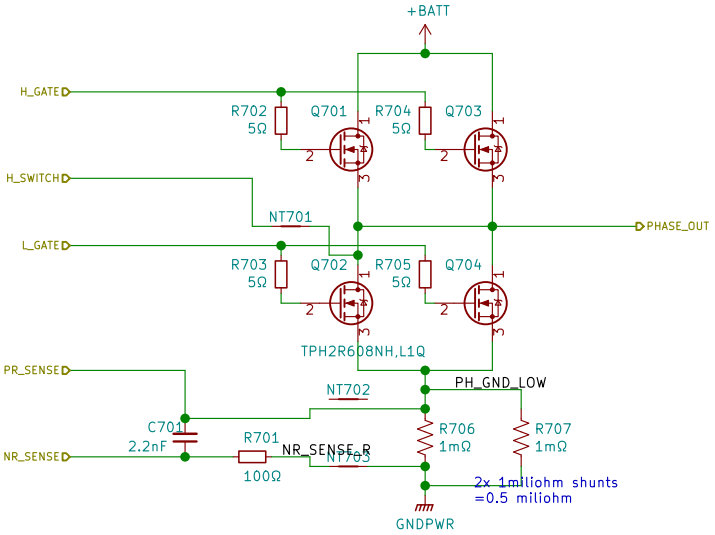
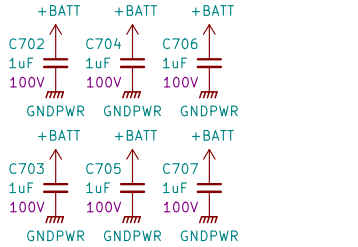
see google spreadsheet





place caps as close to fets as possible.
can be replaced with 2.2uf caps if needed

kelvin connect shb_x to bottom fet drain to try out fet r current sense.
put i sense filter resistor on snc_x to be able to disconnect it and connecto to fet as well.

draws 50-100ma from 3.3v
1.4mm tall, fets are 1 mm

U801

PHASE_V_1_ADC 14 PA0(ADC123_IN0/WKUP)
PHASE_V_2_ADC 15 PA1(ADC123_IN1)
PHASE_V_3_ADC 16 PA2(ADC123_IN2)
SERVO 17 PA3(ADC123_IN3)
DAC1_ADC 20 PA4(ADC12_IN4/DAC1_OUT)
DAC2_ADC 21 PA5(ADC12_IN5/DAC2_OUT)
AUX1_PWM 22 PA6(ADC12_IN6)
AUX2_PWM 23 PA7(ADC12_IN7)
H1 41 PA8
H2 42 PA9(OTG_FS_VBUS)
H3 43 PA10
USB_DM 44 PA11
USB_DP 45 PA12

ADC_THROTTLE 26 PB0(ADC12_IN8)
ADC_BRAKE 27 PB1(ADC12_IN9)
BRAKE_SW 57 PB5
USART1_TX 58 PB6
USART1_RX 59 PB7
CAN_RX 61 PB8
CAN_TX 62 PB9
SCL_2 29 PB10
SDA_2 30 PB11
FAULT 33 PB12
L1 34 PB13(OTG_HS_VBUS)
L2 35 PB14
L3 36 PB15

PHASE_CURRENT_1_ADC 8 PC0(ADC123_IN10)
PHASE_CURRENT_2_ADC 9 PC1(ADC123_IN11)
PHASE_CURRENT_3_ADC 10 PC2(ADC123_IN12)
ADC_VBUS 11 PC3(ADC123_IN13)
ADC_TEMP 24 PC4(ADC12_IN14)
TEMP_MOTOR 25 PC5(ADC12_IN15)
HALL_1 37 PC6
HALL_2 38 PC7
HALL_3 39 PC8
EN_GATE 40 PC9
USART3_TX 51 PC10
USART3_RX 52 PC11
SPI3_MOSI 53 PC12
REVERSE_SW 2 PC13_(RTC_AF1)

54 PD2

PC14-OSC32_IN 3 LED_GREEN
PC15-OSC32_OUT 4 LED_RED

PH0-OSC_IN 5
PH1-OSC_OUT 6

BOOT0(VPP) 60 BOOT_0
PB2-BOOT1 28

NRST 7

PA13(JTMS-SWDIO) 46 SWDIO
PA14(JTCK-SWCLK) 49 SWCLK
PA15(JTDI) 50 SPI3_NSS
PB3(JTDO/TRACESWO) 55 SPI3_SCK
PB4(NJTRST) 56 SPI3_MISO

VDD 19
VDD 32
VDD 48
VDD 64

VSS 18
VSS 63

VBAT 1

VDDA 13
VSSA 12

VCAP1 31
VCAP2 47

STM32F40X_LQFP64

servo sig should also go to adc
check that 5v tolerant?

15p C806
15p C808
X801 8MHz 10ppm
oscillator wrong footprint

Reset pin internally pulled up
NRST
100n C804

boot0 high for dfu mode
SW801 SW_Push
BOOT_0
C813 100n
R804 10k
add switch/ through hole jumper to enter dfu usb fw mode

needs to source 15ma
for hall sensor power

+3.3V replace some of these with 100nf caps?
2.2u C807
2.2u C809
2.2u C810
2.2u C811
2.2u C812
Bypass, place next to VDD pins

2.2u C802
2.2u C805
2.2u C801
2.2u C803
GNDA

make bogopin freindly?
only need to program once.
maybe smd pads on underside
except for debugging - need connector for that.
maybe 1.0mm pitch optionally placeable?

J801 SWD
SWCLK 2
SWDIO 4
NRST 5
Programming / Debug connector
change to 4 pin remove vcc? or add swo?
connector not populated by default, for sw debug

+3.3V
R801 1k BLUE D802
LED_GREEN
R802 1k GREEN D803
LED_RED
R803 1k RED D804

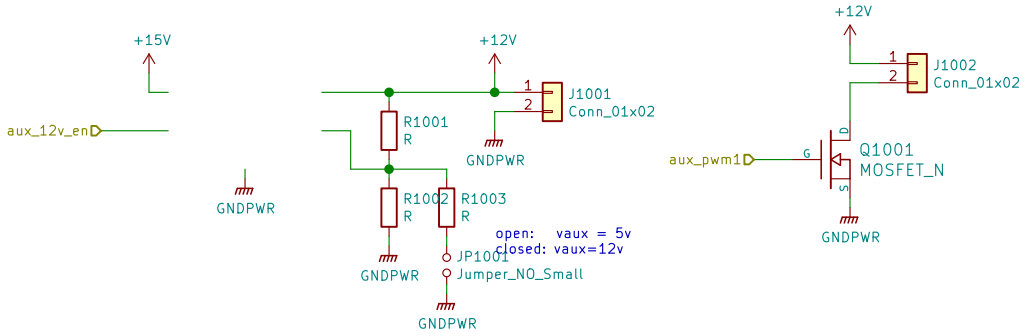
LQFP64
VBAT 1
PC13 2
PC14 3
PC15 4
PH0 5
PH1 6
NRST 7
PC0 8
PC1 9
PC2 10
PC3 11
VSSA 12
VDDA 13
PA0_WKUP 14
PA1 15
PA2 16
PA3 17
VSS 18
VDD 19
PA4 20
PA5 21
PA6 22
PA7 23
PC4 24
PC5 25
PB0 26
PB1 27
PB2 28
PB10 29
PB11 30
VCAP_1 31
VDD 32
PB12 33
PB13 34
PB14 35
PB15 36
PC6 37
PC7 38
PC8 39
PC9 40
PA8 41
PA9 42
PA10 43
PA11 44
PA12 45
PA13 46
VCAP_2 47
VDD 48
VDD 49
PA14 50
PA15 51
PC10 52
PC11 53
PC12 54
PD2 55
PB3 56
PB4 57
PB5 58
PB6 59
PB7 60
BOOT0 61
PB8 62
PB9 63
VSS 64
VDD

http://www.wireless-tag.com/wireless_module/BLE/WT51822-S4AT.html
or

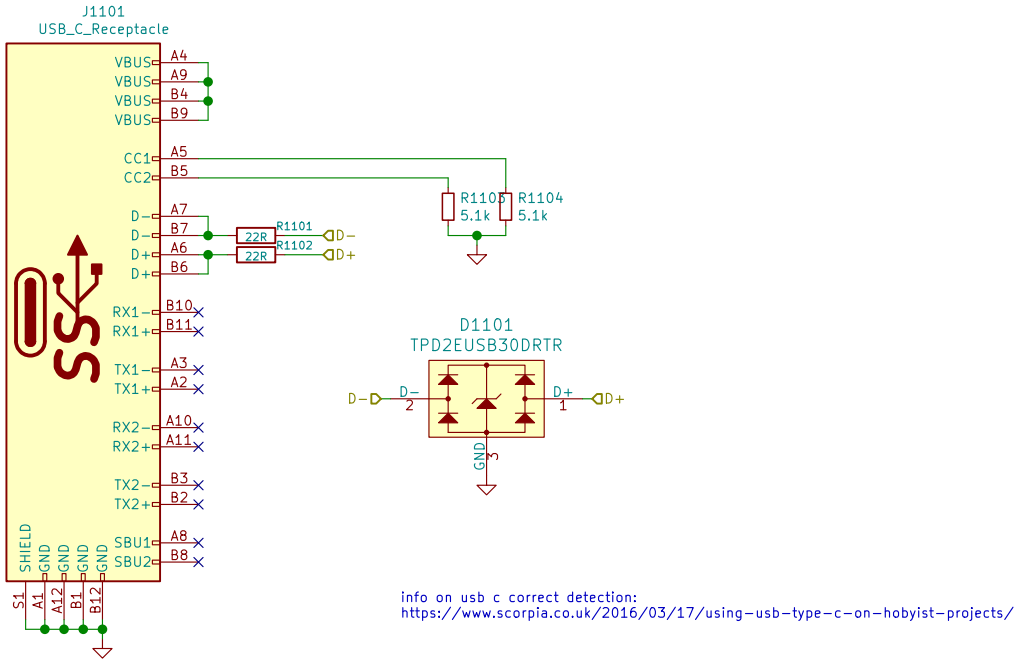
BLE_TX

BLE_RX

+3.3V



12v regulator should have a 100-200ma current limit


J1101
USB_C_Receptacle
VBUS
A4
A9
B4
B9
CC1
CC2
A5
B5
R1103
5.1k
R1104
5.1k
D−
D−
D+
D+
A7
B7
A6
B6
22R
R1101
22R
R1102
D−
D+
RX1−
RX1+
B10
B11
TX1−
TX1+
A3
A2
RX2−
RX2+
A10
A11
TX2−
TX2+
B3
B2
SBU1
SBU2
A8
B8
SHIELD
GND
GND
GND
GND
S1
A1
A12
B1
B12
D1101
TPD2EUSB30DRTR
D−
D−
2
D+
1
D+
GND
3
info on usb c correct detection:
https://www.scorpia.co.uk/2016/03/17/using-usb-type-c-on-hobyist-projects/