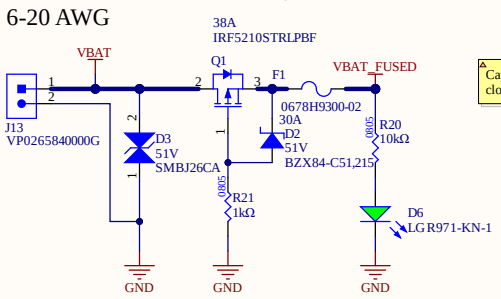
Battery Input (12s1p)

Input voltage range: 36-50.4V

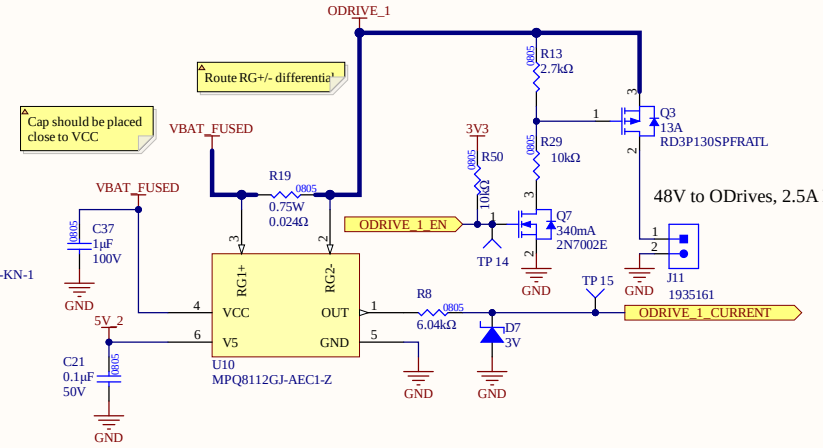
Reverse Polarity Protection



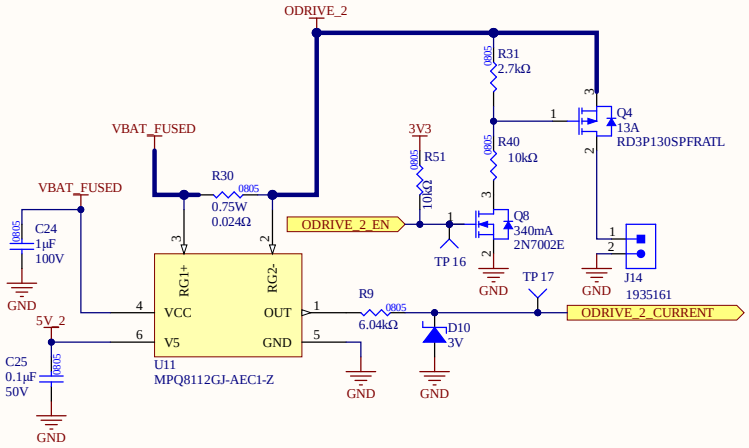
LED forward drop = 2.0V
Max VBAT = 50.4V
Min VBAT = 36V

Max LED current = (50.4-2)/10000 = 4.84mA
Min LED current = (36-2)/10000 = 3.4mA

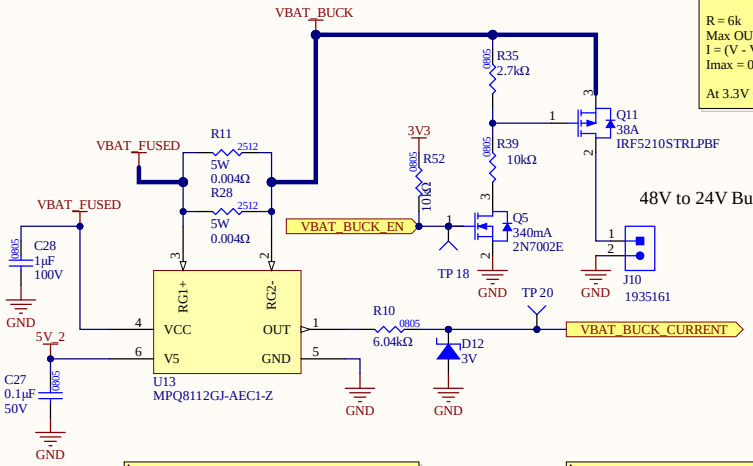
ODrive Load Monitoring



48V to ODrives, 2.5A Each



24V Buck Load Monitoring



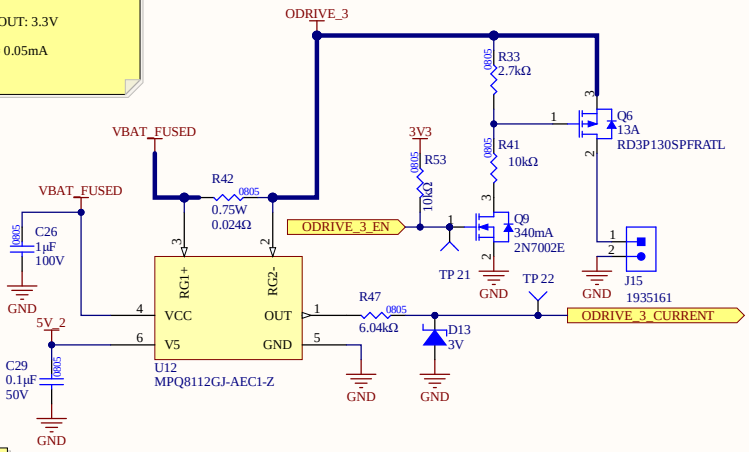
48V to 24V Buck, 15A

Zener Diode Protection

500mW #NAME? 0.167A Max
Izt = 50uA

R = 6k
Max OUT: 6V Min OUT: 3.3V
I = (V - Vz)/R
Imax = 0.5mA Imin = 0.05mA

At 3.3V OUT, Iz = Izt



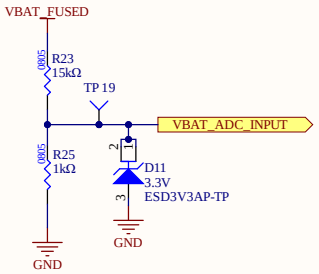
OUT = 50(RG1 - RG2)
OUT: (0-3V)
CURRENT: (0-30A)
RSENSE = 0.002Ohm

OUT MAX = (0.002ohm)(30A)(50) = 3V
MAX_POWER = (0.002ohm)(30A)^2 = 1.8W

OUT = 50(RG1 - RG2)
OUT: (0-1.8V)
CURRENT: (0-2.5A)
RSENSE = 0.012Ohm

OUT MAX = (0.0144ohm)(2.5A)(50) = 3V
MAX_POWER = (0.024ohm)(2.5A)^2 = 0.15W

Power Rail Voltage Monitoring



Divides 48V to 3V

Title: SH1 - 48V POWER.SchDoc		
Project: Power Distribution Board.PrjPcb		
Rev: 6.0	Reviewer: Ari Wasch	
	Engineer: Logan Hartford	
Date: 2024-02-24	Sheet: 1 of 6	

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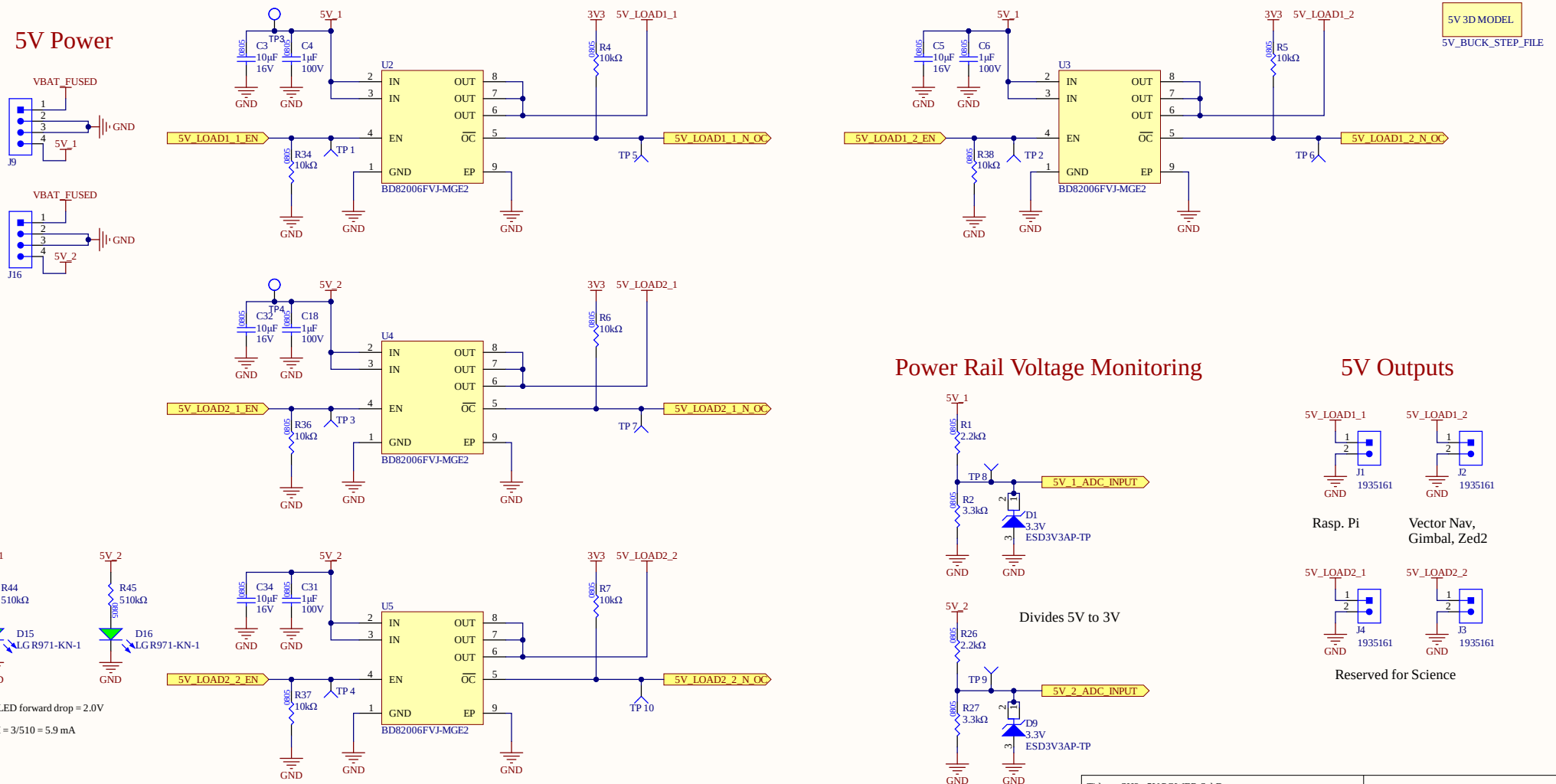
5V Smart High-Side Switches

5V Power



LED forward drop = 2.0V

I = 3/510 = 5.9 mA

Power Rail Voltage Monitoring

Divides 5V to 3V

5V Outputs

Rasp. Pi

Vector Nav, Gimbal, Zed2

Reserved for Science

2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

5V 3D MODEL
5V_BUCK_STEP_FILE

5V 3D MODEL
5V_BUCK_STEP_FILE

Title: SH2 - 5V POWER.SchDoc		
Project: Power Distribution Board.PrjPcb		
Rev: 6.0	Reviewer: Ari Wasch	
	Engineer: Logan Hartford	
Date: 2024-02-24	Sheet: 2 of 6	

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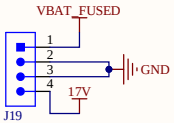
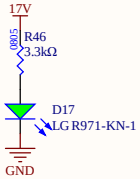
17V Load Monitoring

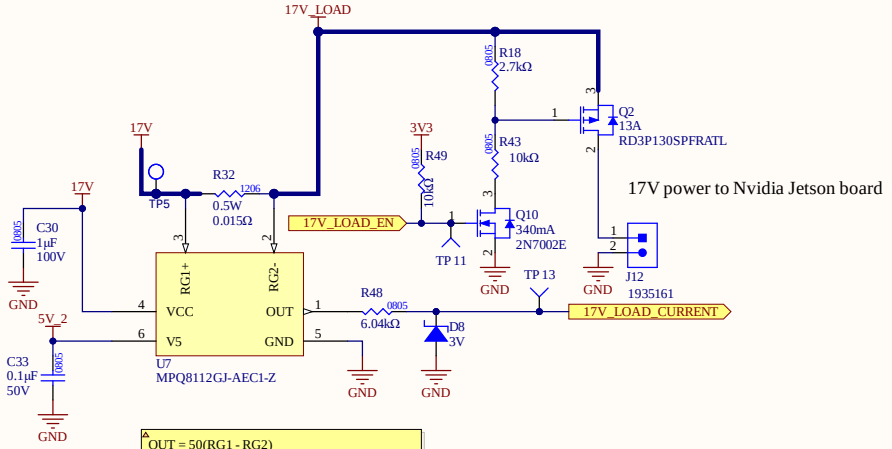
17V Power





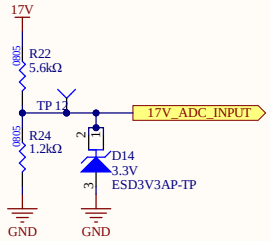
LED forward drop = 2.0V

I = 14/3300 = 4.2 mA



*
17V 3D MODEL
17V_BUCK_STEP_FILE

Power Rail Voltage Monitoring



Divides 17V to 3V

Title: SH3 - 17V POWER.SchDoc		
Project: Power Distribution Board.PrjPcb		
Rev: 6.0	Reviewer: Ari Wasch	
	Engineer: Logan Hartford	
Date: 2024-02-24	Sheet: 3 of 6	

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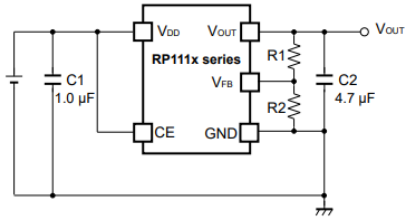


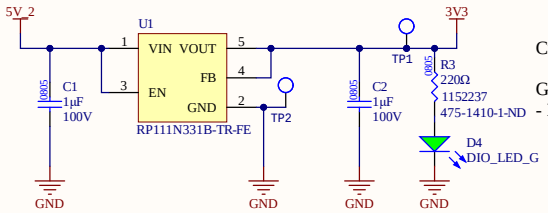
Phase Compensation

Similar to the Fixed Output Voltage Type, Phase compensation is made for the Adjustable Output Voltage Type for securing stable operation even if the load current is varied. For this purpose, use a 4.7µF or more capacitor C2 between V_{OUT} pin and GND pin, and as close as possible to the pins.

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0µF or more between V_{DD} and GND pin, and as close as possible to the pins.

3.3V LDO @ 500mA Max



Current Calculations

Green LED voltage drop: 2.2V
- I = (3.3-2.2V)/220 = 5mA

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0µF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

Title: SH4 - 3.3V LINEAR REGULATOR.SchDoc		
Project: Power Distribution Board.PrjPcb		
Rev: 6.0	Reviewer: Ari Wasch	
	Engineer: Logan Hartford	
Date: 2024-02-24	Sheet: 4 of 6	

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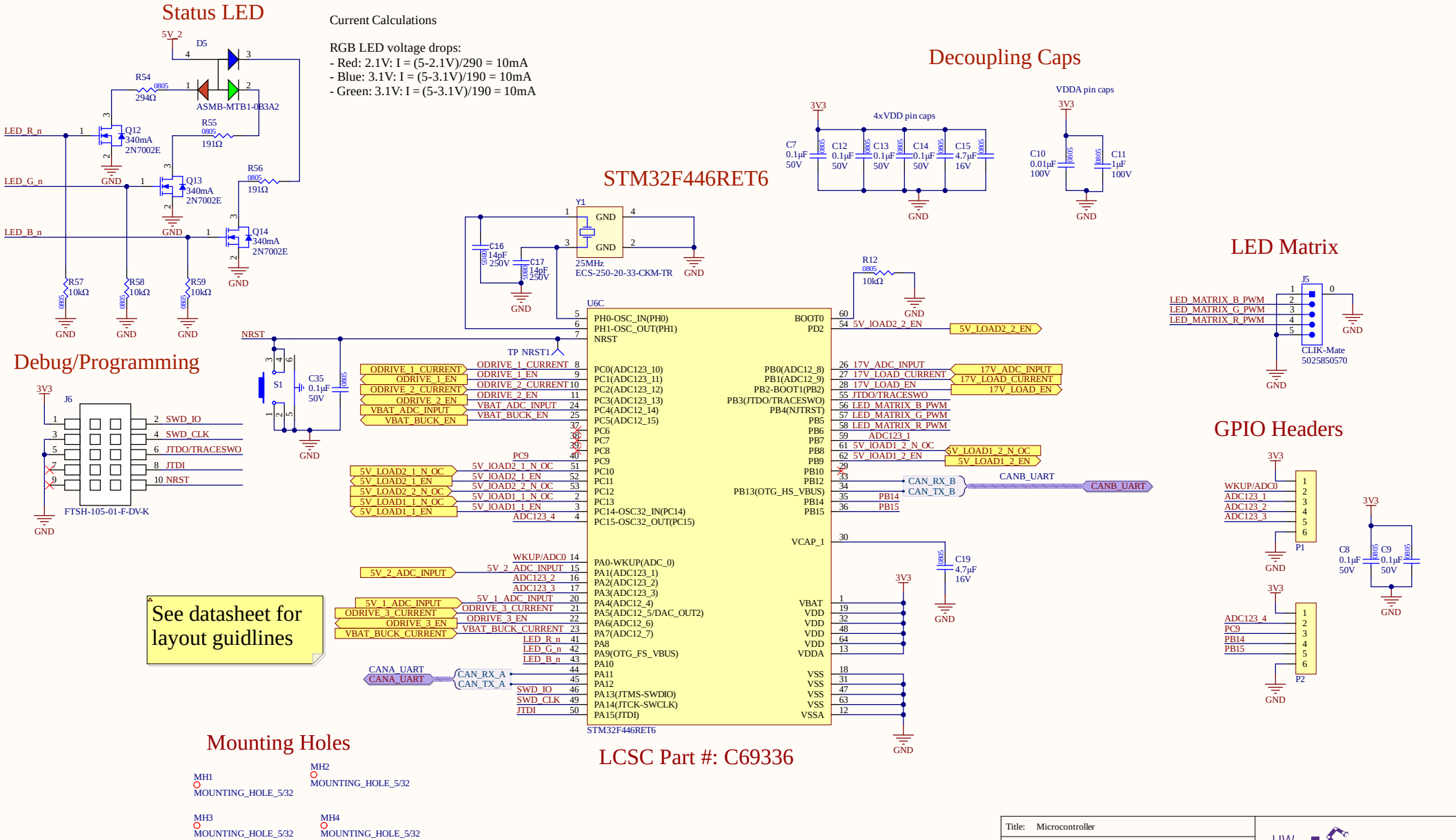
Status LED
Current Calculations
RGB LED voltage drops:
- Red: 2.1V: I = (5-2.1V)/290 = 10mA
- Blue: 3.1V: I = (5-3.1V)/190 = 10mA
- Green: 3.1V: I = (5-3.1V)/190 = 10mA
5V_2
D5
ASMB-MTB1-0B3A2
R54
294Ω
R55
191Ω
R56
191Ω
LED_R_n
LED_G_n
LED_B_n
Q12
340mA
2N7002E
Q13
340mA
2N7002E
Q14
340mA
2N7002E
R57
10kΩ
R58
10kΩ
R59
10kΩ
GND
Decoupling Caps
4xVDD pin caps
VDDA pin caps
3V3
C7
0.1µF
50V
C12
0.1µF
50V
C13
0.1µF
50V
C14
0.1µF
50V
C15
4.7µF
16V
C10
0.01µF
100V
C11
1µF
100V
STM32F446RET6
Y1
25MHz
ECS-250-20-33-CKM-TR
C16
14pF
250V
C17
14pF
250V
U6C
PH0-OSC_IN(PH0)
PH1-OSC_OUT(PH1)
NRST
PC0(ADC123_10)
PC1(ADC123_11)
PC2(ADC123_12)
PC3(ADC123_13)
PC4(ADC12_14)
PC5(ADC12_15)
PC6
PC7
PC8
PC9
PC10
PC11
PC12
PC13
PC14-OSC32_IN(PC14)
PC15-OSC32_OUT(PC15)
PA0-WKUP(ADC_0)
PA1(ADC123_1)
PA2(ADC123_2)
PA3(ADC123_3)
PA4(ADC12_4)
PA5(ADC12_5/DAC_OUT2)
PA6(ADC12_6)
PA7(ADC12_7)
PA8
PA9(OTG_FS_VBUS)
PA10
PA11
PA12
PA13(JTMS-SWDIO)
PA14(JTCK-SWCLK)
PA15(JTDI)
BOOT0
PD2
PB0(ADC12_8)
PB1(ADC12_9)
PB2-BOOT1(PB2)
PB3(JTDO/TRACESWO)
PB4(NJTRST)
PB5
PB6
PB7
PB8
PB9
PB10
PB12
PB13(OTG_HS_VBUS)
PB14
PB15
VCAP_1
VBAT
VDD
VSS
VSSA
R12
10kΩ
5V_LOAD2_2_EN
17V_ADC_INPUT
17V_LOAD_CURRENT
17V_LOAD_EN
JTDO/TRACESWO
LED_MATRIX_B_PWM
LED_MATRIX_G_PWM
LED_MATRIX_R_PWM
ADC123_1
5V_LOAD2_1_N_OC
5V_LOAD2_1_EN
5V_LOAD2_2_N_OC
5V_LOAD1_1_N_OC
5V_LOAD1_1_EN
5V_LOAD1_2_N_OC
5V_LOAD1_2_EN
CAN_RX_B
CAN_TX_B
CANB_UART
ADC123_4
5V_2_ADC_INPUT
5V_1_ADC_INPUT
ODRIVE_3_CURRENT
ODRIVE_3_EN
VBAT_BUCK_CURRENT
LED_R_n
LED_G_n
LED_B_n
CANA_UART
CAN_RX_A
CAN_TX_A
SWD_IO
SWD_CLK
JTDI
STM32F446RET6
Debug/Programming
J6
SWD_IO
SWD_CLK
JTDO/TRACESWO
JTDI
NRST
FTSH-105-01-F-DV-K
S1
C35
0.1µF
50V
NRST
TP NRST1
ODRIVE_1_CURRENT
ODRIVE_1_EN
ODRIVE_2_CURRENT
ODRIVE_2_EN
VBAT_ADC_INPUT
VBAT_BUCK_EN
PC9
See datasheet for layout guidlines
LED Matrix
J5
CLIK-Mate
5025850570
GPIO Headers
P1
P2
WKUP/ADC0
ADC123_1
ADC123_2
ADC123_3
ADC123_4
PC9
PB14
PB15
C8
0.1µF
50V
C9
0.1µF
50V
C19
4.7µF
16V
Mounting Holes
MH1
MOUNTING_HOLE_5/32
MH2
MOUNTING_HOLE_5/32
MH3
MOUNTING_HOLE_5/32
MH4
MOUNTING_HOLE_5/32
LCSC Part #: C69336
Title: Microcontroller
Project: Power Distribution Board.PrjPcb
Rev: 6.0
Reviewer: Ari Wasch
Engineer: Logan Hartford
Date: 2024-02-24
Sheet: 5 of 6
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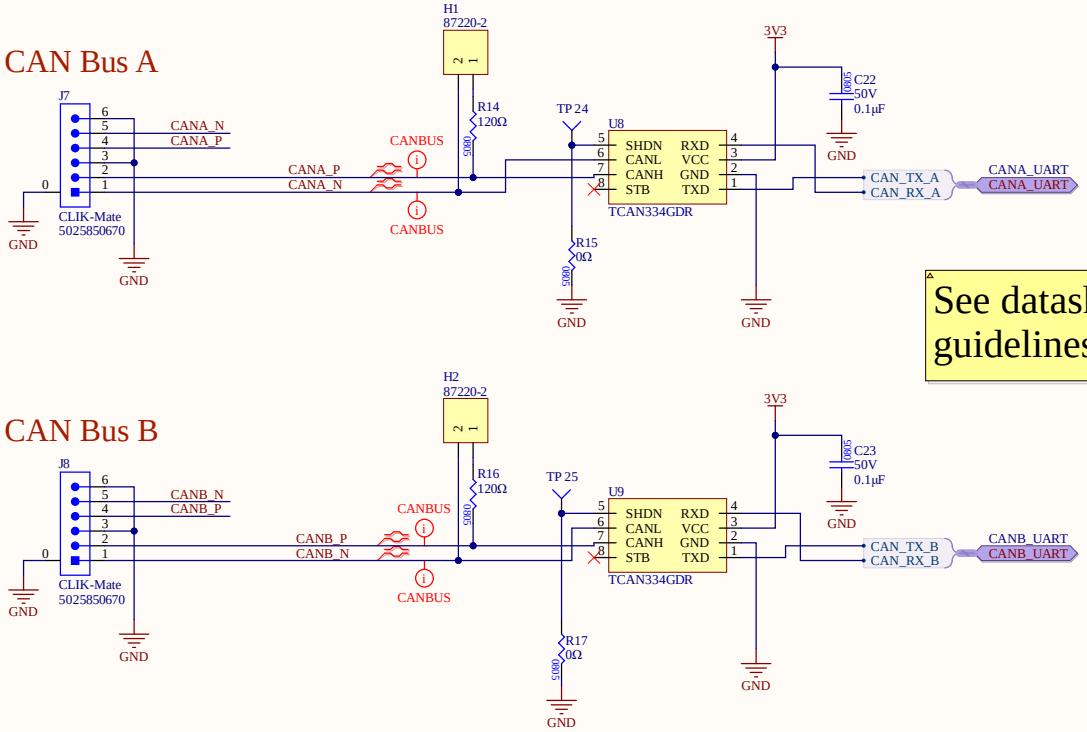
CAN Transceivers



See datasheet for layout guidelines

Title: SH6 - CAN.SchDoc		
Project: Power Distribution Board.PrjPcb		
Rev: 6.0	Reviewer: Ari Wasch	
	Engineer:	
Date: 2024-02-24	Sheet: 6 of 6	

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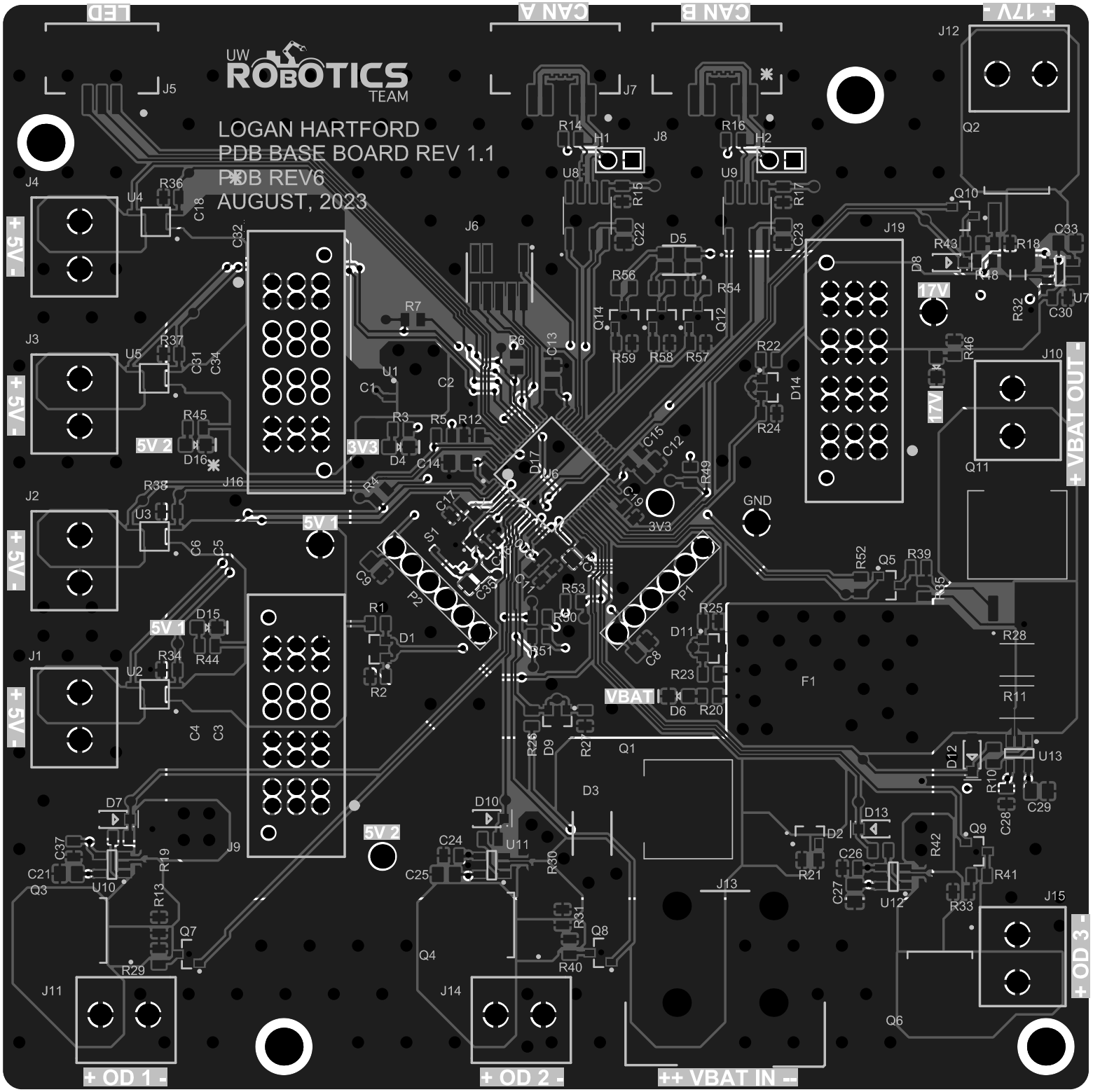
UW ROBOTICS TEAM
LOGAN HARTFORD
PDB BASE BOARD REV 1.1
PDB REV6
AUGUST, 2023
LED
CAN A
CAN B
+ 17V -
+ 5V -
+ VBAT OUT -
+ OD 3 -
+ OD 1 -
+ OD 2 -
++ VBAT IN --
5V 1
5V 2
3V3
17V
VBAT
GND