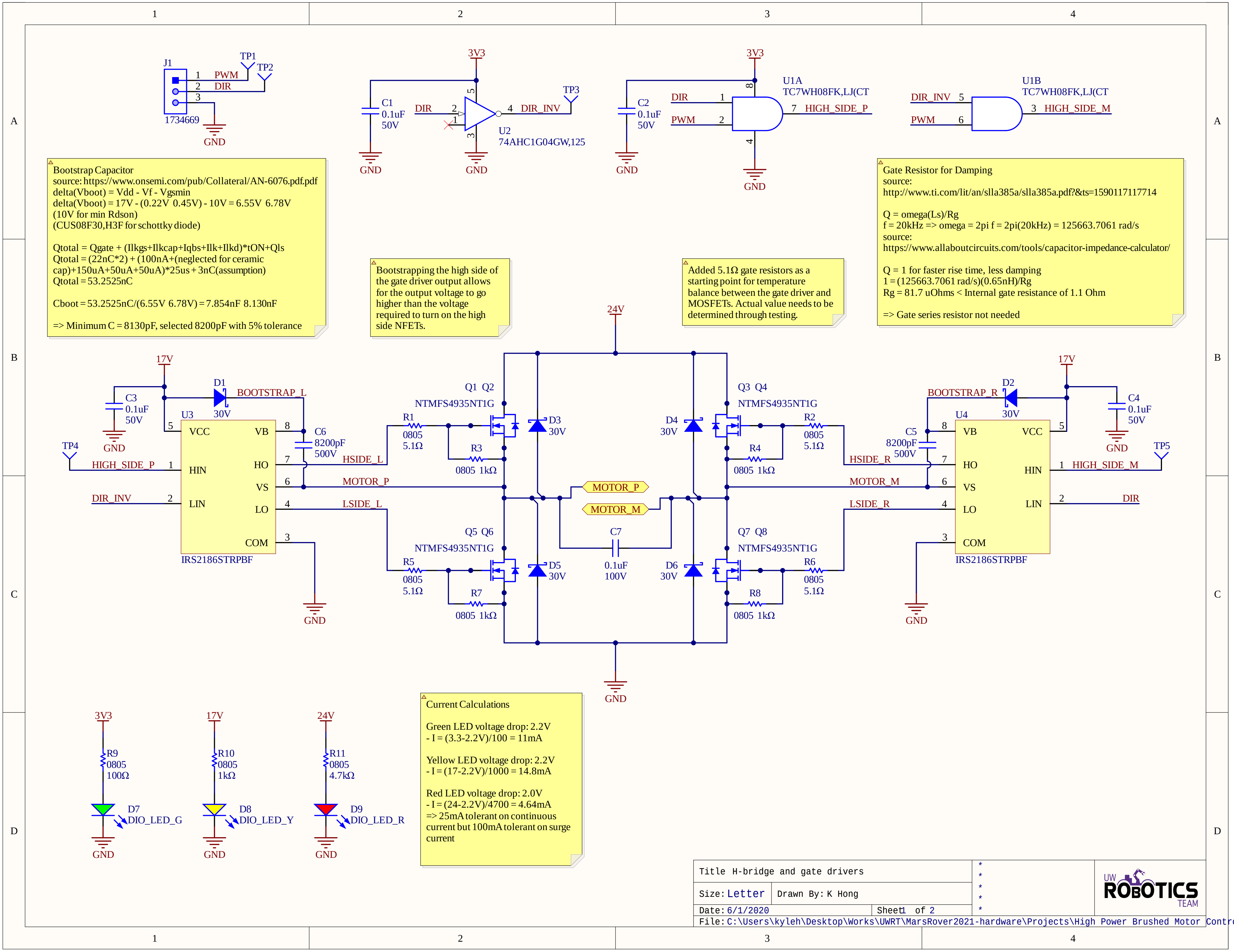

J1
1734669
1 PWM
2 DIR
3
TP1
TP2
GND
3V3
C1
0.1uF
50V
DIR
DIR_INV
TP3
U2
74AHC1G04GW,125
GND
3V3
C2
0.1uF
50V
DIR
PWM
U1A
TC7WH08FK,LJ(CT
HIGH_SIDE_P
GND
U1B
TC7WH08FK,LJ(CT
DIR_INV
PWM
HIGH_SIDE_M
Bootstrap Capacitor
source: https://www.onsemi.com/pub/Collateral/AN-6076.pdf.pdf
delta(Vboot) = Vdd - Vf - Vgsmin
delta(Vboot) = 17V - (0.22V 0.45V) - 10V = 6.55V 6.78V
(10V for min Rdson)
(CUS08F30,H3F for schottky diode)
Qtotal = Qgate + (Ilkgs+Ilkcap+Iqbs+Ilk+Ilkd)*tON+Qls
Qtotal = (22nC*2) + (100nA+(neglected for ceramic cap)+150uA+50uA+50uA)*25us + 3nC(assumption)
Qtotal = 53.2525nC
Cboot = 53.2525nC/(6.55V 6.78V) = 7.854nF 8.130nF
=> Minimum C = 8130pF, selected 8200pF with 5% tolerance
Bootstrapping the high side of the gate driver output allows for the output voltage to go higher than the voltage required to turn on the high side NFETs.
Added 5.1Ω gate resistors as a starting point for temperature balance between the gate driver and MOSFETs. Actual value needs to be determined through testing.
Gate Resistor for Damping
source:
http://www.ti.com/lit/an/slla385a/slla385a.pdf?&ts=1590117117714
Q = omega(Ls)/Rg
f = 20kHz => omega = 2pi f = 2pi(20kHz) = 125663.7061 rad/s
source:
https://www.allaboutcircuits.com/tools/capacitor-impedance-calculator/
Q = 1 for faster rise time, less damping
1 = (125663.7061 rad/s)(0.65nH)/Rg
Rg = 81.7 uOhms < Internal gate resistance of 1.1 Ohm
=> Gate series resistor not needed
24V
17V
C3 0.1uF 50V
D1 30V
BOOTSTRAP_L
U3
IRS2186STRPBF
VCC VB HIN HO VS LIN LO COM
C6 8200pF 500V
TP4
HIGH_SIDE_P
DIR_INV
HSIDE_L
MOTOR_P
LSIDE_L
GND
Q1 Q2
NTMFS4935NT1G
R1 0805 5.1Ω
R3 0805 1kΩ
D3 30V
Q3 Q4
NTMFS4935NT1G
R2 0805 5.1Ω
R4 0805 1kΩ
D4 30V
MOTOR_P
MOTOR_M
C7 0.1uF 100V
Q5 Q6
NTMFS4935NT1G
R5 0805 5.1Ω
R7 0805 1kΩ
D5 30V
Q7 Q8
NTMFS4935NT1G
R6 0805 5.1Ω
R8 0805 1kΩ
D6 30V
GND
17V
D2 30V
BOOTSTRAP_R
C4 0.1uF 50V
U4
IRS2186STRPBF
C5 8200pF 500V
HSIDE_R
MOTOR_M
LSIDE_R
TP5
HIGH_SIDE_M
DIR
GND
3V3
R9 0805 100Ω
D7 DIO_LED_G
17V
R10 0805 1kΩ
D8 DIO_LED_Y
24V
R11 0805 4.7kΩ
D9 DIO_LED_R
GND
Current Calculations
Green LED voltage drop: 2.2V
- I = (3.3-2.2V)/100 = 11mA
Yellow LED voltage drop: 2.2V
- I = (17-2.2V)/1000 = 14.8mA
Red LED voltage drop: 2.0V
- I = (24-2.2V)/4700 = 4.64mA
=> 25mA tolerant on continuous current but 100mA tolerant on surge current
Title H-bridge and gate drivers
Size: Letter
Drawn By: K Hong
Date: 6/1/2020
Sheet1 of 2
File: C:\Users\kyleh\Desktop\Works\UWRT\MarsRover2021-hardware\Projects\High Power Brushed Motor Control
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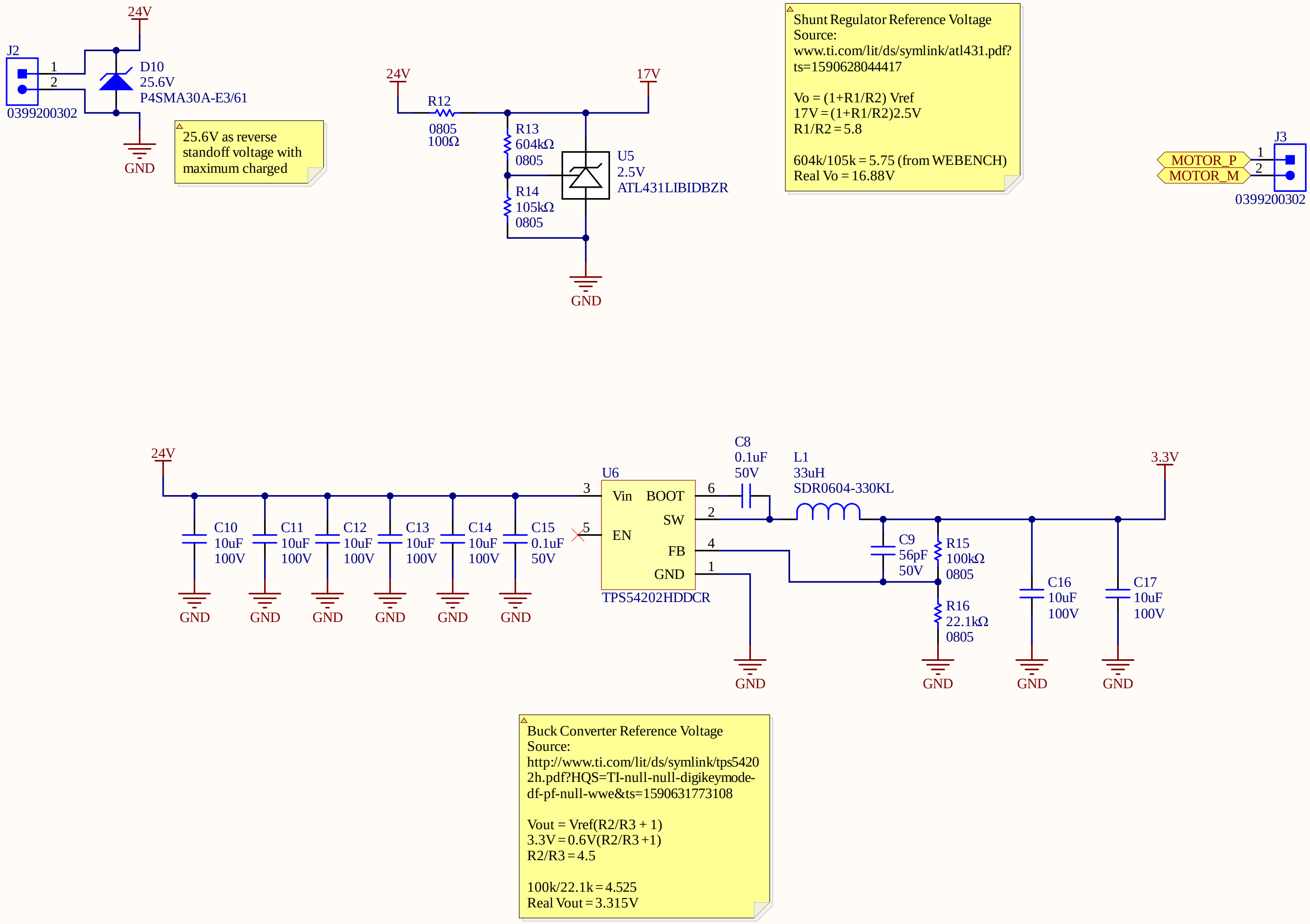

Title Connectors and PDB

Size: Letter | Drawn By: Kyle Hong

Date: 6/1/2020 | Sheet 2 of 2

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