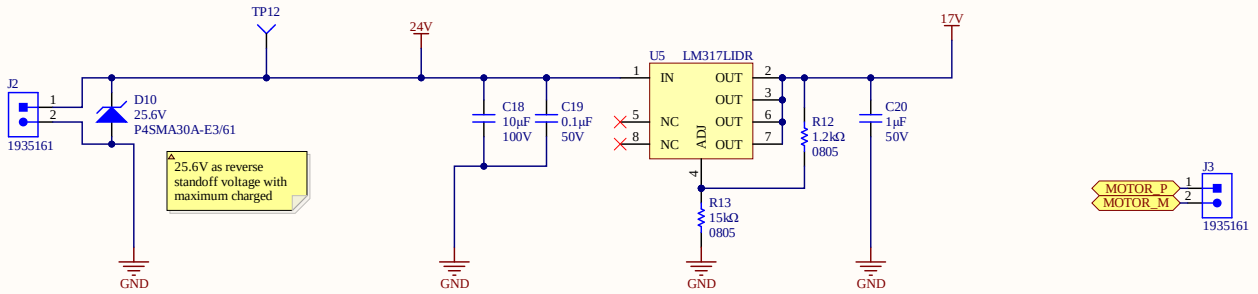

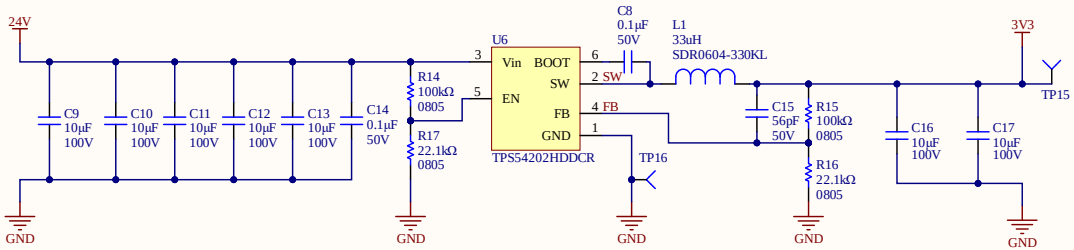

Buck Converter Reference Voltage
Source:
http://www.ti.com/lit/ds/symlink/tps54202h.pdf?HQS=TI-null-null-digikeymode-df-pf-null-wwe&ts=1590631773108

Vout = Vref(R2/R3 + 1)
3.3V = 0.6V(R2/R3 +1)
R2/R3 = 4.5

100k/22.1k = 4.525
Real Vout = 3.315V

EN voltage divider:
Logic high level for EN pin = 1.28 - 7V

Ven = 24(22.1/(22.1+100))
Ven = 4.34V

Title: Connectors and Power		
Project: High Power Brushed DC MC.PrjPcb		
Rev: 2	Checker: Lance Bantoto	
	Engineer: Kyle Hong	
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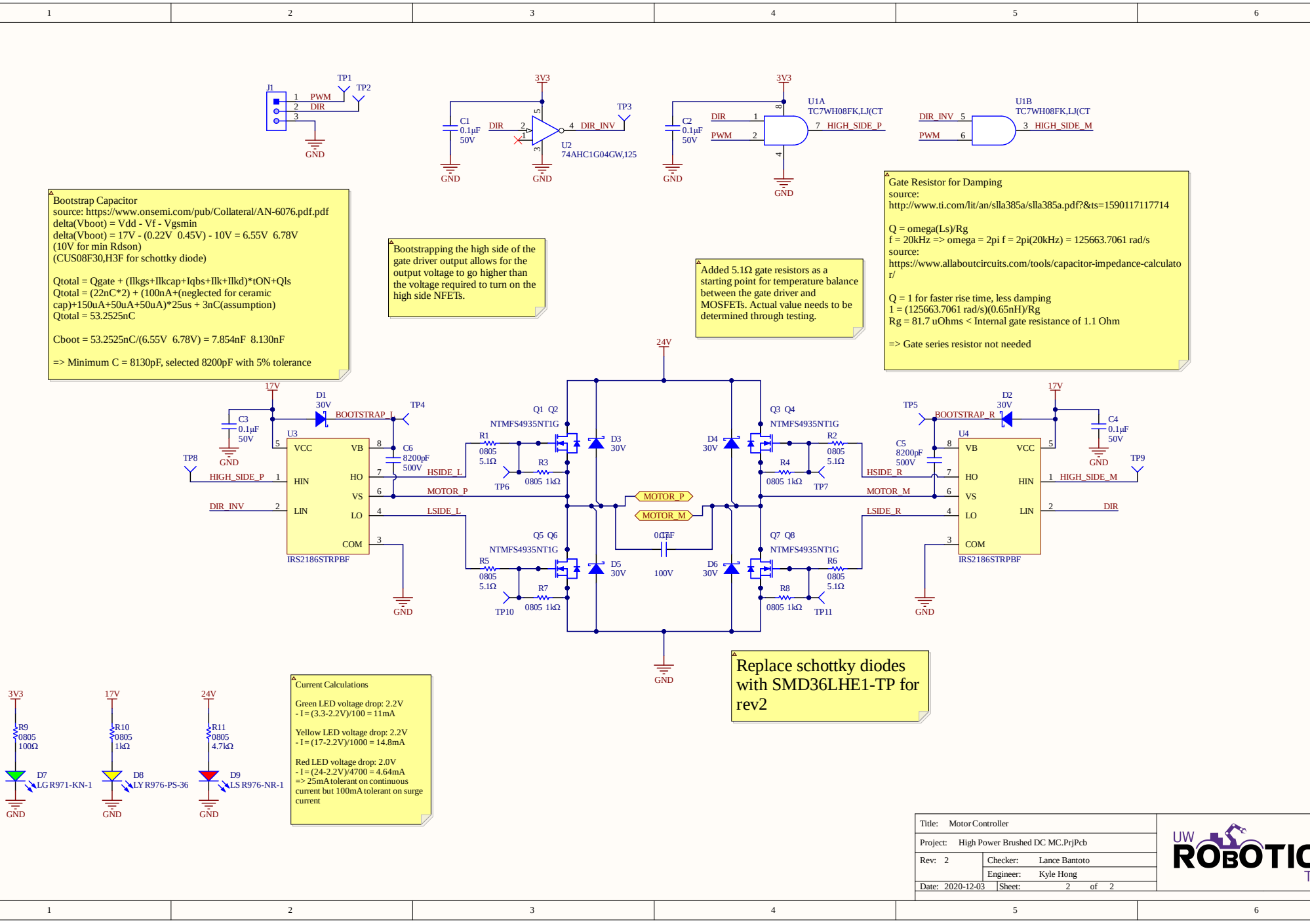
J1
PWM
DIR
TP1
TP2
GND
3V3
C1
0.1µF
50V
DIR
DIR_INV
TP3
U2
74AHC1G04GW,125
C2
0.1µF
50V
U1A
TC7WH08FK,LJ(CT
HIGH_SIDE_P
U1B
TC7WH08FK,LJ(CT
DIR_INV
PWM
HIGH_SIDE_M
Bootstrap Capacitor
source: https://www.onsemi.com/pub/Collateral/AN-6076.pdf.pdf
delta(Vboot) = Vdd - Vf - Vgsmin
delta(Vboot) = 17V - (0.22V 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
17V
D1
30V
BOOTSTRAP_L
TP4
C3
0.1µF
50V
U3
VCC
VB
HO
VS
HIN
LIN
COM
IRS2186STRPBF
C6
8200pF
500V
TP8
HIGH_SIDE_P
DIR_INV
HSIDE_L
MOTOR_P
LSIDE_L
24V
Q1 Q2
NTMFS4935NT1G
R1
0805
5.1Ω
R3
0805 1kΩ
TP6
D3
30V
D4
30V
Q3 Q4
NTMFS4935NT1G
R2
0805
5.1Ω
R4
0805 1kΩ
TP7
MOTOR_P
MOTOR_M
0Ω
100V
Q5 Q6
NTMFS4935NT1G
R5
0805
5.1Ω
R7
0805 1kΩ
TP10
D5
30V
D6
30V
Q7 Q8
NTMFS4935NT1G
R6
0805
5.1Ω
R8
0805 1kΩ
TP11
GND
TP5
BOOTSTRAP_R
D2
30V
17V
C4
0.1µF
50V
C5
8200pF
500V
U4
VB
VCC
HO
HIN
VS
LO
LIN
COM
IRS2186STRPBF
TP9
HIGH_SIDE_M
DIR
HSIDE_R
MOTOR_M
LSIDE_R
Replace schottky diodes with SMD36LHE1-TP for rev2
3V3
R9
0805
100Ω
D7
LG R971-KN-1
17V
R10
0805
1kΩ
D8
LY R976-PS-36
24V
R11
0805
4.7kΩ
D9
LS R976-NR-1
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: Motor Controller
Project: High Power Brushed DC MC.PrjPcb
Rev: 2
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