

**Bootstrap Capacitor**  
 source: <https://www.onsemi.com/pub/Collateral/AN-6076.pdf>  
 $\Delta V_{boot} = V_{dd} - V_f - V_{gsmin}$   
 $\Delta V_{boot} = 17V - (0.22V + 0.45V) - 10V = 6.55V$   
 (10V for min  $R_{dsn}$ )  
 (CUS08F30, H3F for schottky diode)

$Q_{total} = Q_{gate} + (I_{lks} + I_{lkcap} + I_{qbs} + I_{lk} + I_{lkd}) \cdot t_{ON} + Q_{ls}$   
 $Q_{total} = (22nC \cdot 2) + (100nA + \text{neglected for ceramic cap}) + 150uA + 50uA + 50uA \cdot 25us + 3nC$  (assumption)  
 $Q_{total} = 53.2525nC$

$C_{boot} = 53.2525nC / (6.55V - 6.78V) = 7.854nF$   
 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.

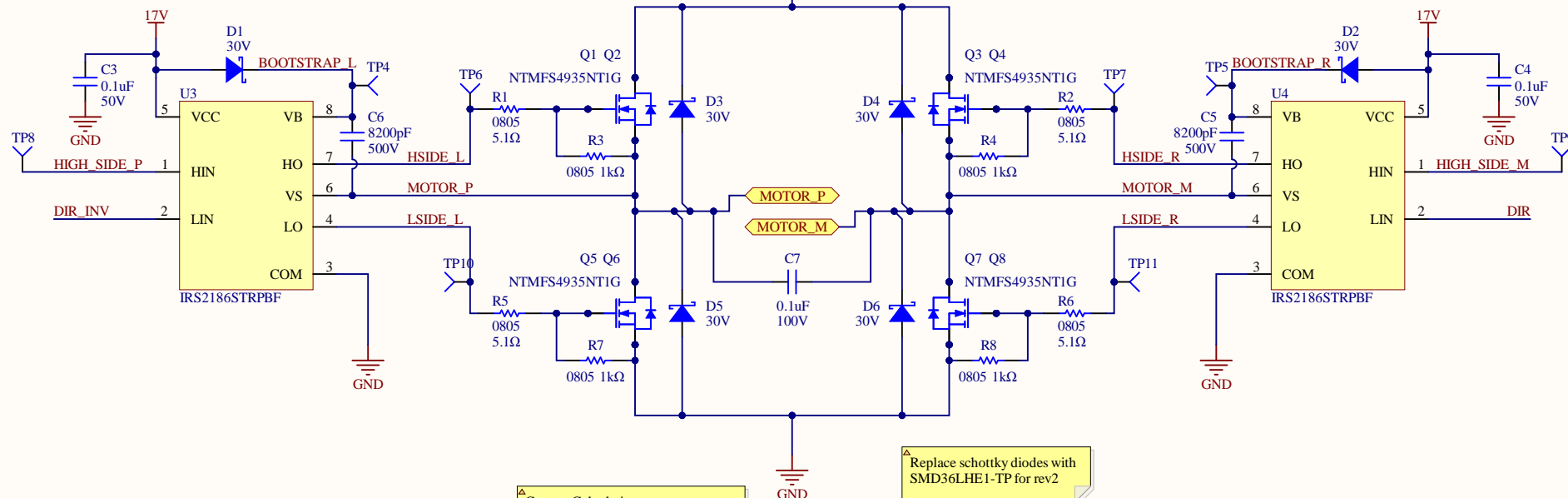
Added 5.1Ω gate resistors as a starting point for temperature balance between the gate driver and MOSFETs. Actual value needs to be determined through testing.

**Gate Resistor for Damping**  
 source: <http://www.ti.com/lit/an/slla385a/slla385a.pdf?ts=1590117117714>

$Q = \omega(L_s)/R_g$   
 $f = 20kHz \Rightarrow \omega = 2\pi f = 2\pi(20kHz) = 125663.7061 \text{ rad/s}$   
 source: <https://www.allaboutcircuits.com/tools/capacitor-impedance-calculator/>

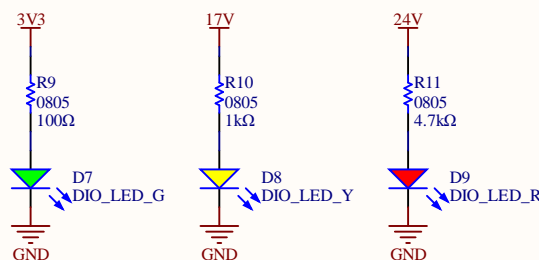
$Q = 1$  for faster rise time, less damping  
 $1 = (125663.7061 \text{ rad/s}) / (0.65nH) / R_g$   
 $R_g = 81.7 \mu\Omega < \text{Internal gate resistance of } 1.1 \Omega$

=> Gate series resistor not needed



Replace schottky diodes with SMD36LHE1-TP for rev2

**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



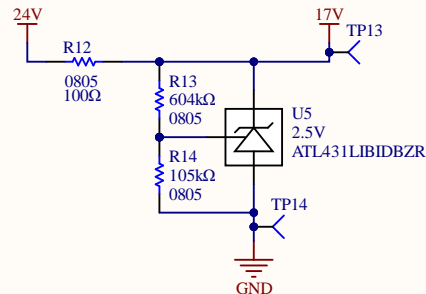
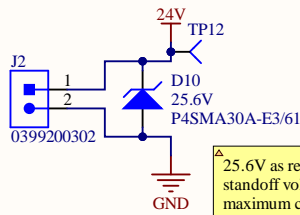
Title H-bridge and gate drivers

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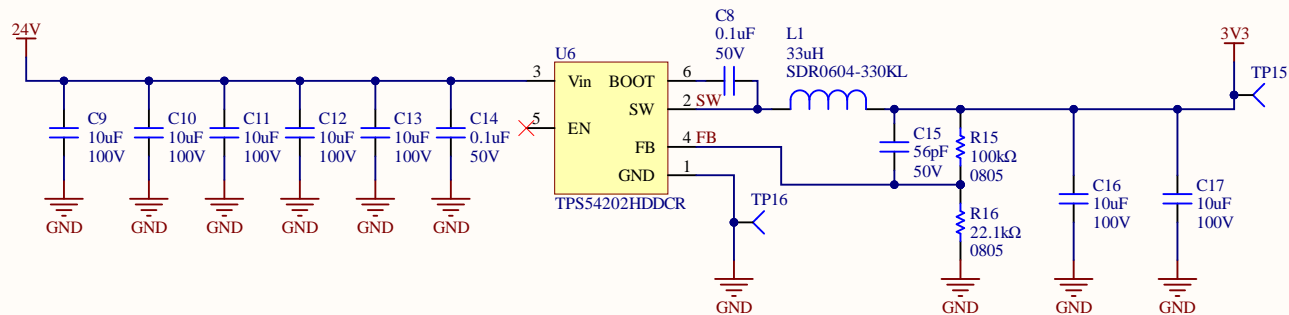
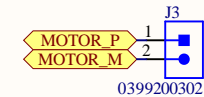
Date: 6/5/2020

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Shunt Regulator Reference Voltage  
 Source:  
[www.ti.com/lit/ds/symlink/atl431.pdf?ts=1590628044417](http://www.ti.com/lit/ds/symlink/atl431.pdf?ts=1590628044417)  
 $V_o = (1 + R_1/R_2) V_{ref}$   
 $17V = (1 + R_1/R_2) 2.5V$   
 $R_1/R_2 = 5.8$   
 $604k/105k = 5.75$  (from WEBENCH)  
 Real  $V_o = 16.88V$



Buck Converter Reference Voltage  
 Source:  
<http://www.ti.com/lit/ds/symlink/tps54202h.pdf?HQS=TI-null-null-digikeymode-df-pf-null-ww&ts=1590631773108>  
 $V_{out} = V_{ref}(R_2/R_3 + 1)$   
 $3.3V = 0.6V(R_2/R_3 + 1)$   
 $R_2/R_3 = 4.5$   
 $100k/22.1k = 4.525$   
 Real  $V_{out} = 3.315V$

