

Bootstrap Capacitor
source: <https://www.onsemi.com/pub/Collateral/AN-6076.pdf>
 $\Delta V_{boot} = V_{dd} - V_f - V_{gsmin}$
 $\Delta V_{boot} = 17V - (0.22V + 0.45V) - 10V = 6.55V$ 6.78V
(10V for min R_{dsn})
(CUS08F30,H3F for schottky diode)

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

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

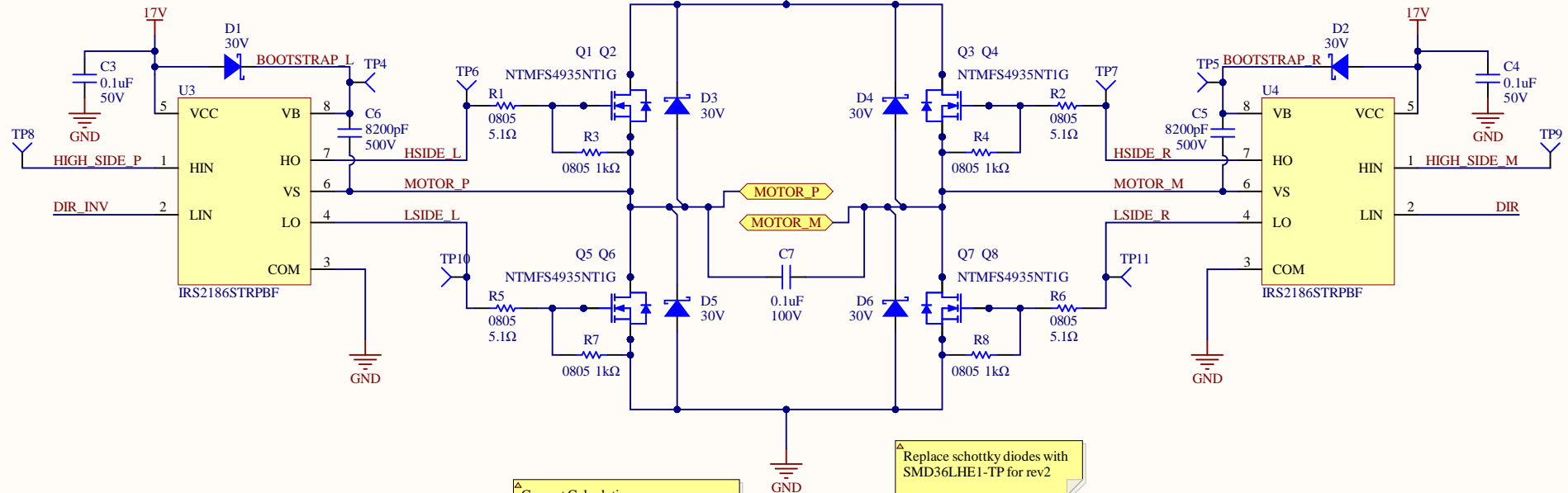
Added 5.1Ω gate resistors as a starting point for temperature balance between the gate driver and MOSFETs. Actual value needs to be determined through testing.

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/>

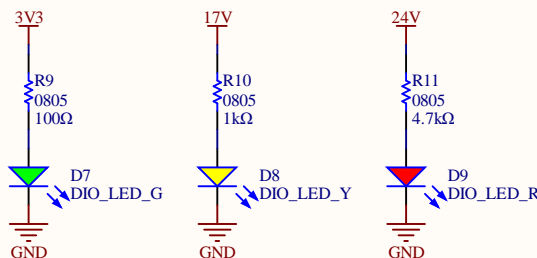
$Q = 1$ for faster rise time, less damping
 $1 = (125663.7061 \text{ rad/s}) / (0.65nH) / R_g$
 $R_g = 81.7 \mu\Omega < \text{Internal gate resistance of } 1.1 \Omega$

=> 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



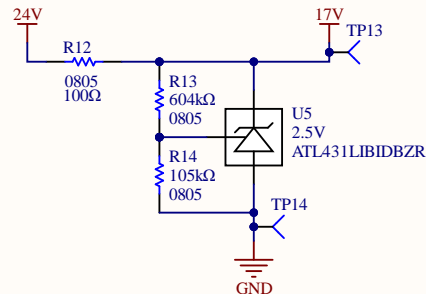
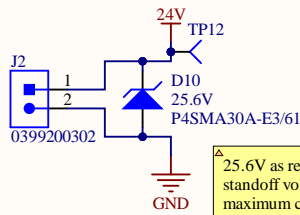
Title H-bridge and gate drivers

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Date: 6/3/2020

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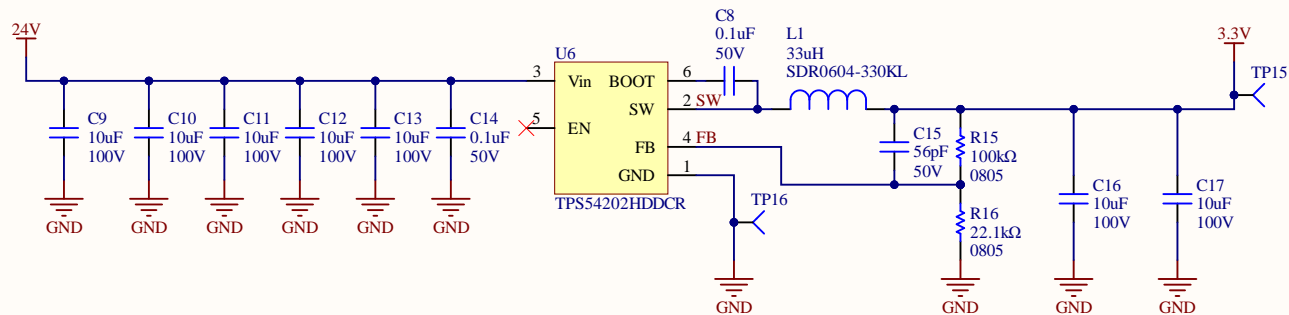
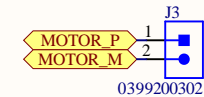
Shunt Regulator Reference Voltage
Source:
www.ti.com/lit/ds/symlink/atl431.pdf?ts=1590628044417

$$V_o = (1 + R_1/R_2) V_{ref}$$

$$17V = (1 + R_1/R_2) 2.5V$$

$$R_1/R_2 = 5.8$$

$$604k/105k = 5.75 \text{ (from WEBENCH)}$$

$$\text{Real } V_o = 16.88V$$


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>

$$V_{out} = V_{ref}(R_2/R_3 + 1)$$

$$3.3V = 0.6V(R_2/R_3 + 1)$$

$$R_2/R_3 = 4.5$$

$$100k/22.1k = 4.525$$

$$\text{Real } V_{out} = 3.315V$$