Batt to 12V Buck Calculations

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Design Requirements for Buck Selection

V_{in}: 24V-60V

- 24V is what the eCVT motors run off of
- 60V is V_{max} according to Baja SAE rules

V_{out}: 12V

- 12V is what we send around the car and what we cascade off of for 3V3 and 5V

I_{load}: 8.4A nominal, 12A for FOS of 1.43

- Calculated in Power draw section

Efficiency: > 90%

Fsw: 500 kHz

- Better efficiency
- Cleaner output ripple

Operating temperature range: -40C to 100C

Output ripple: 10%

Power Draw of the entire system

Components	Power Draw (W)	Operating Voltage (V)	Current Draw (A)
Electronics System run off of battery	327.364	24.00	13.64
Electronics system run off of 12v buck	100.844	12.00	8.40
Motherboard	317.38	24.00	13.22
eCVT	1.78	3.30	0.19
SAS	0.70	3.30	0.21
TL	0.70	3.30	0.21
DAQ	0.57	3.30	0.17
Radio	1.31	12.00	0.62
IMU/GPS	1.02	12.00	0.53
Front Breakout	1.26	12.00	0.64
Rear Breakout	1.03	12.00	0.59
Dashboard	0.89	12.00	0.50

12A/8.40A = 1.43 FOS

Electrons System Calculator (Last Year's System)

Inductor Selection

Ripple current

$$\Delta I_L = 0.3 \cdot I_{Lmax}$$
$$\Delta I_L = 0.3 \cdot 12$$
$$\Delta I_L = 3.6A$$

Inductor

$$L = \frac{V_{out}\left(1 - \frac{V_{out}}{V_{in}}\right)}{\Delta I_L \cdot f_{sw}}$$

$$L = \frac{12V\left(1 - \frac{12V}{60V}\right)}{3.6A \cdot 500KHz}$$

$$L = \frac{12V(1-0.2)}{3.6A \cdot 500KHz}$$

$$L = \frac{9.6}{1800000}$$

$$L = 5.3\,MH$$

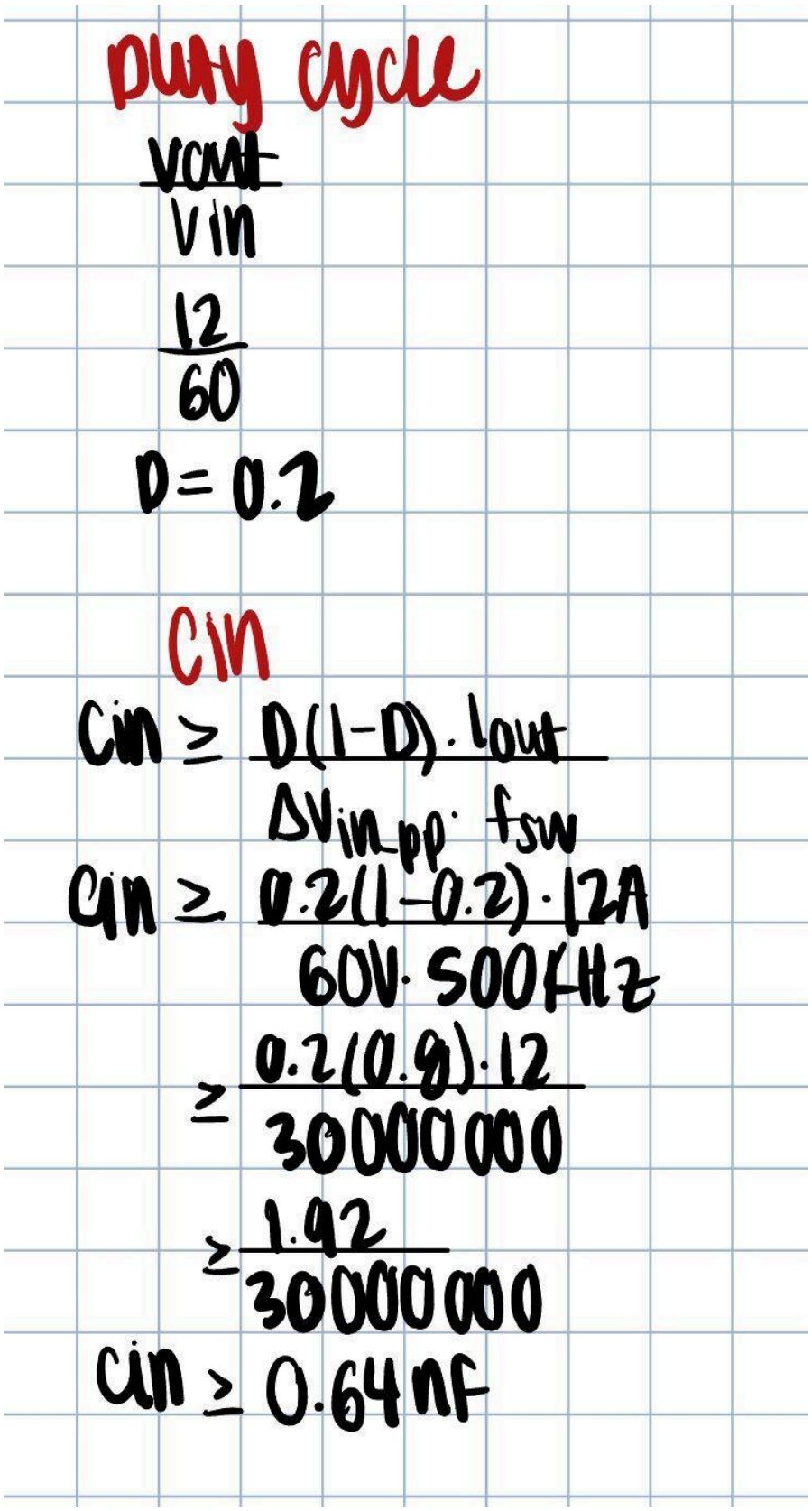
SRP1040VA-5R6M

Mosfet Selection

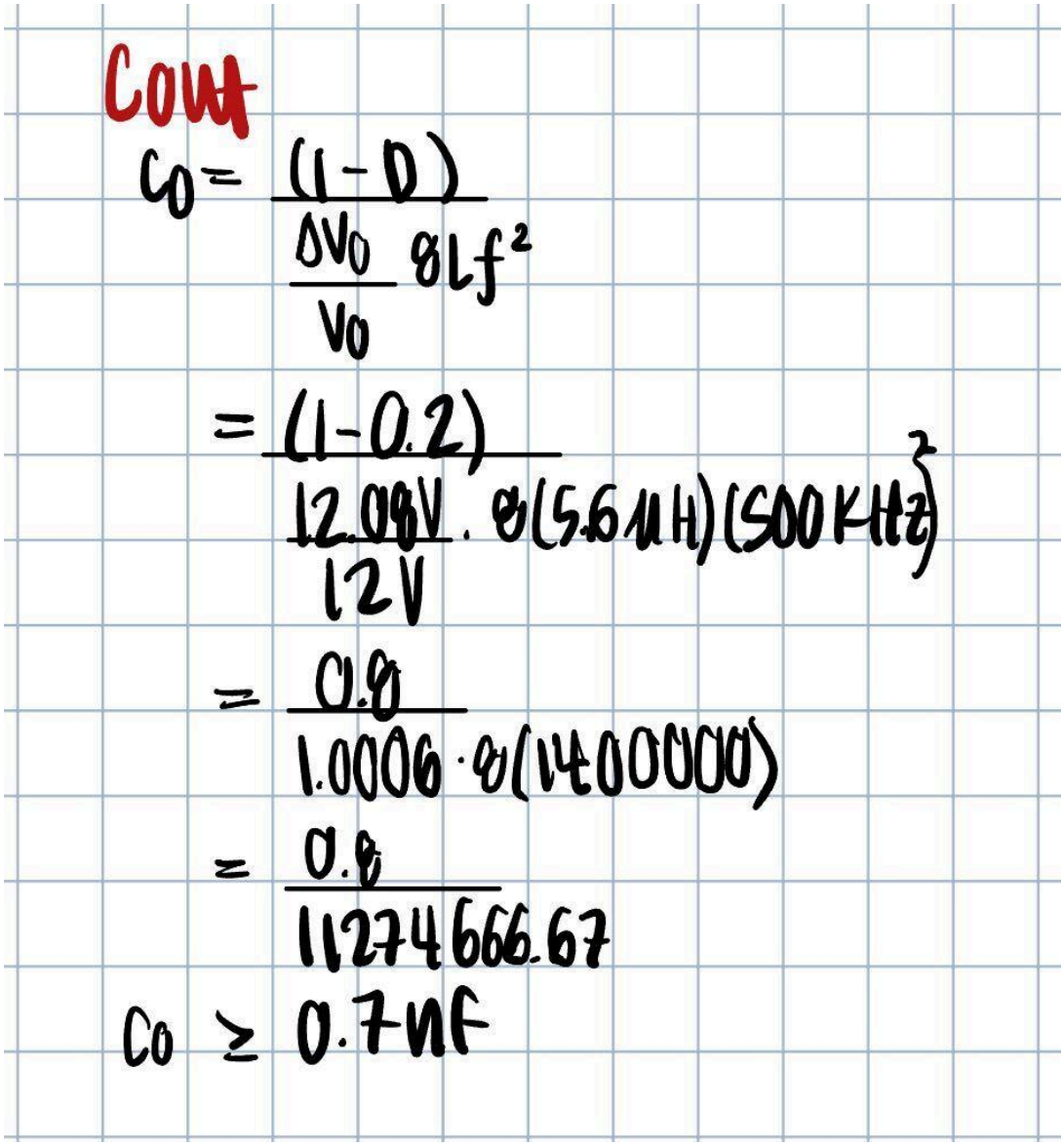
- V_{DS} = 60V
- I_D = 48A
- $V_{GateSource}$ = -4 to 6V
- Q_G = 5nC
- R_{DS} = 2.6 mOhms

EPC2031

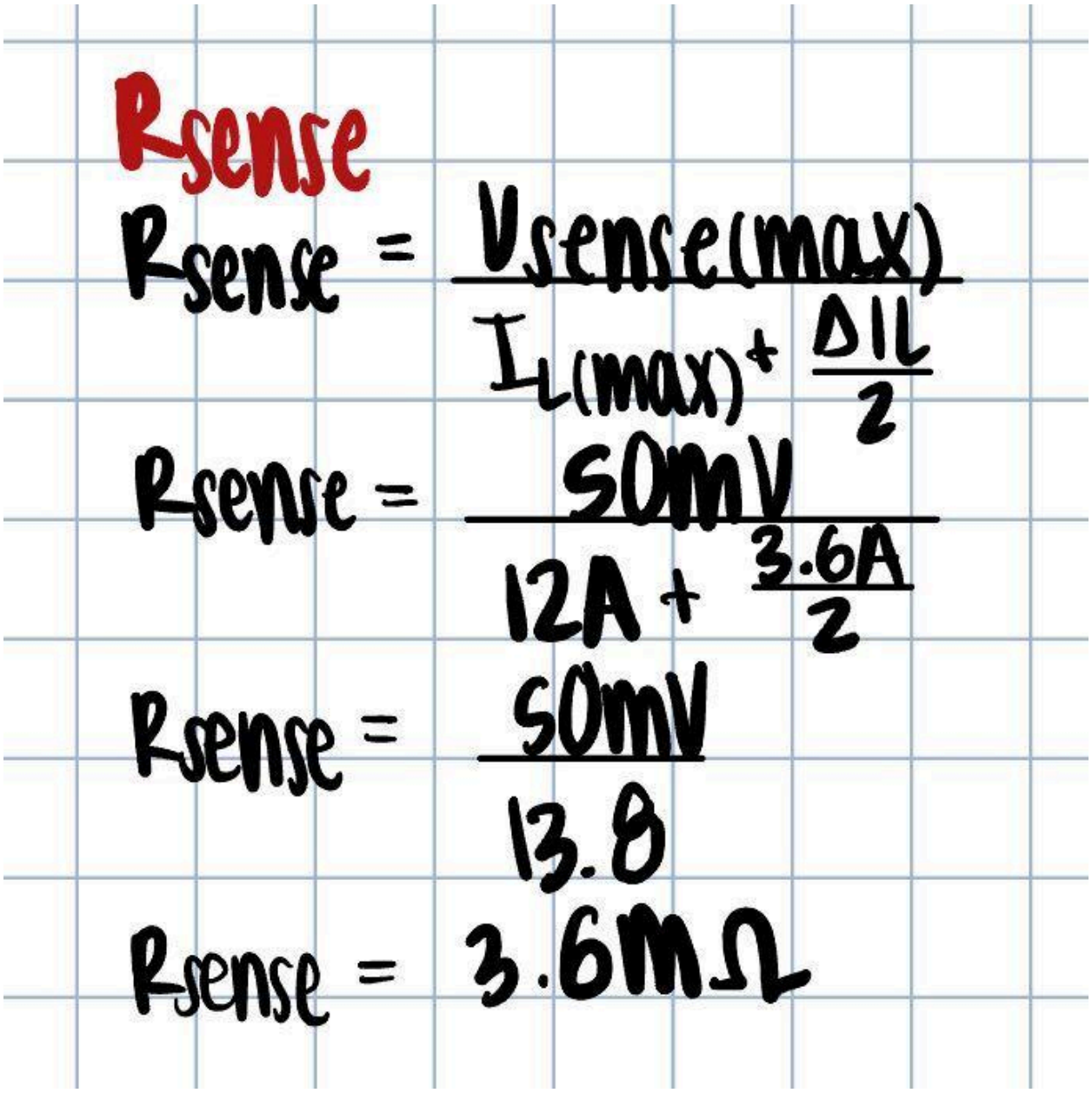
C_{in} Selection



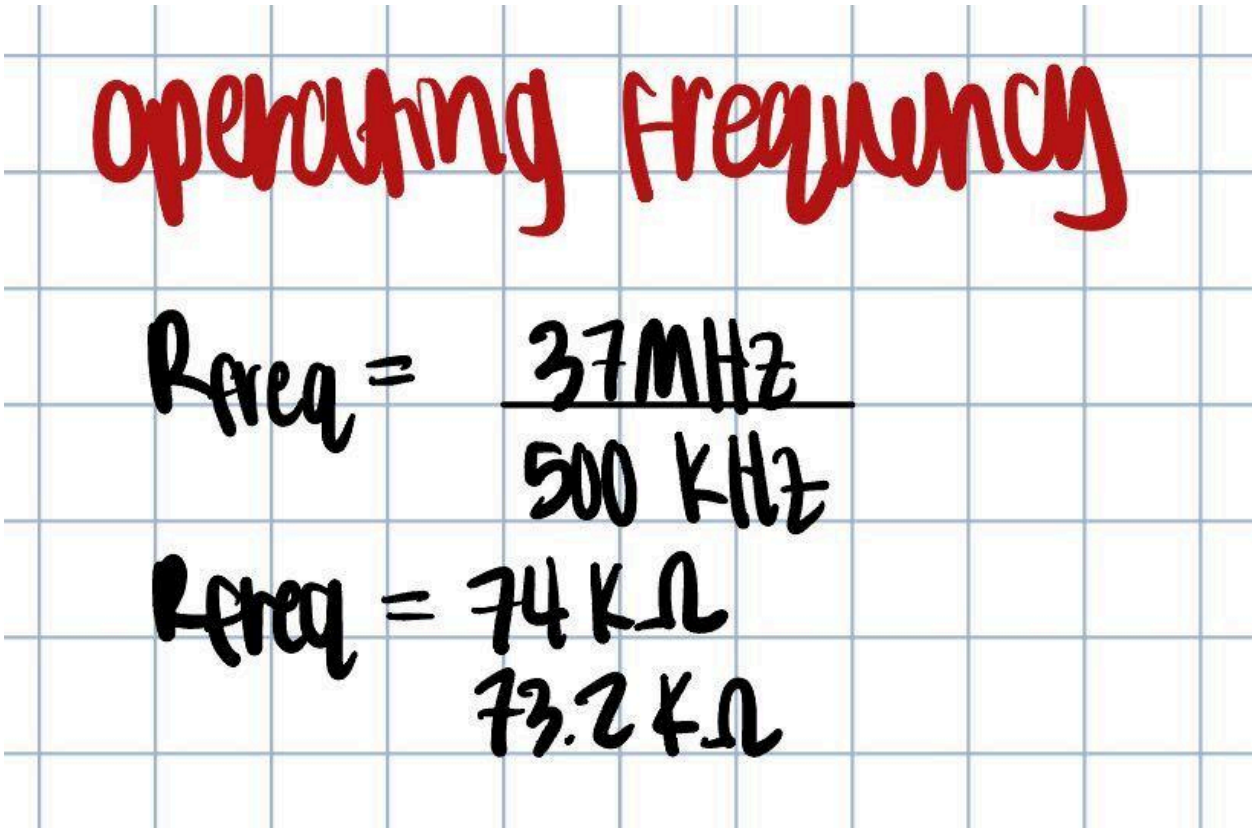
C_{out} Selection



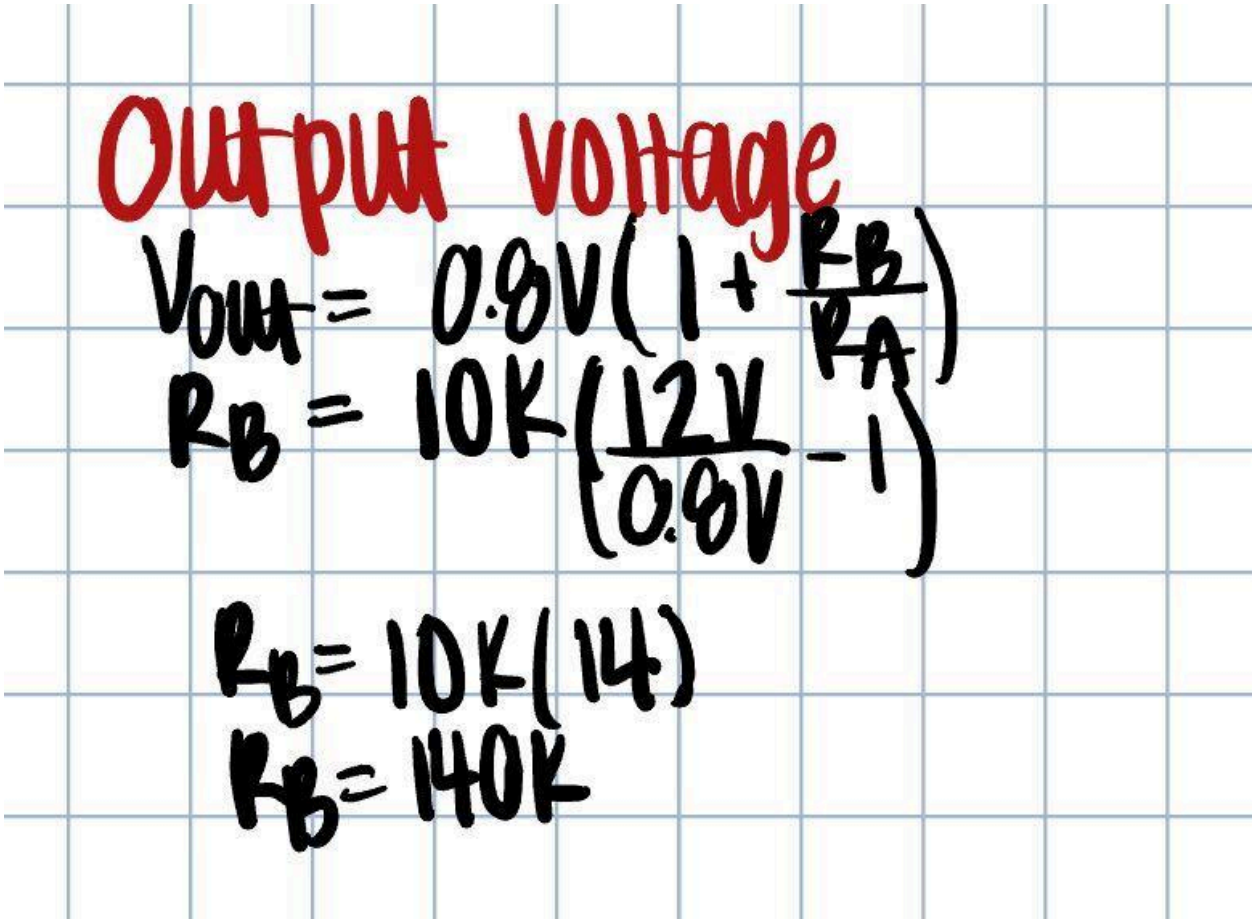
R_{sense} Selection



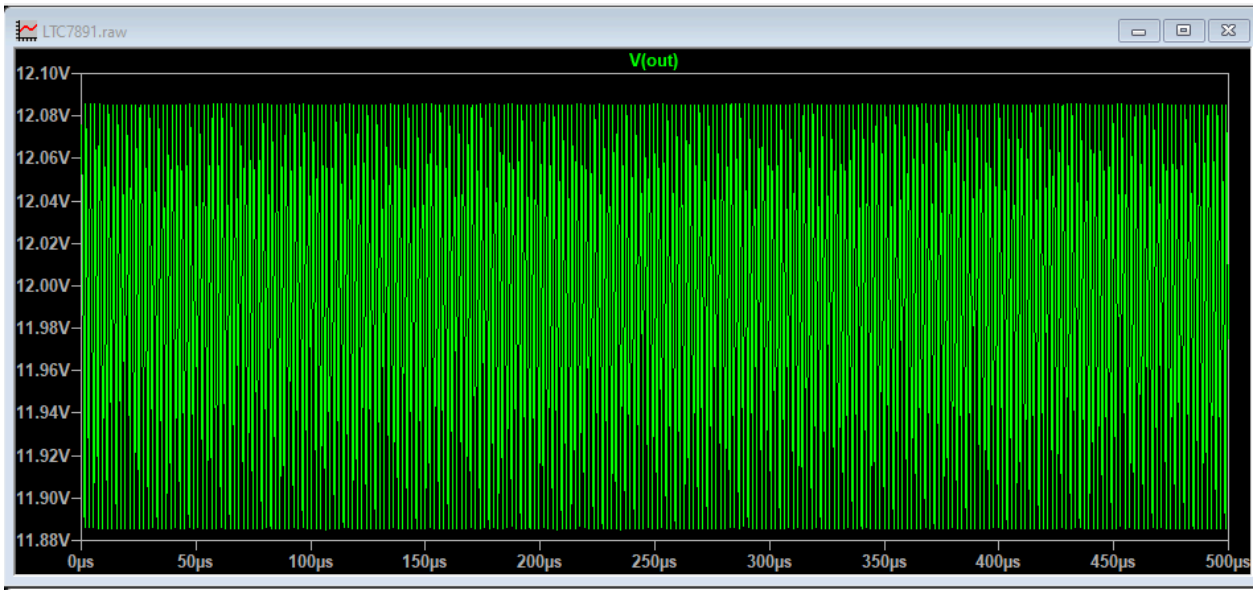
Frequency Resistor Selection



V_{fb} Selection



Voltage Output Ripple Simulation



Voltage output ripple

12.09V − 11.88V

$= \frac{0.21V}{12V}$

$= 1.7\%$

Current through the Inductor Simulation