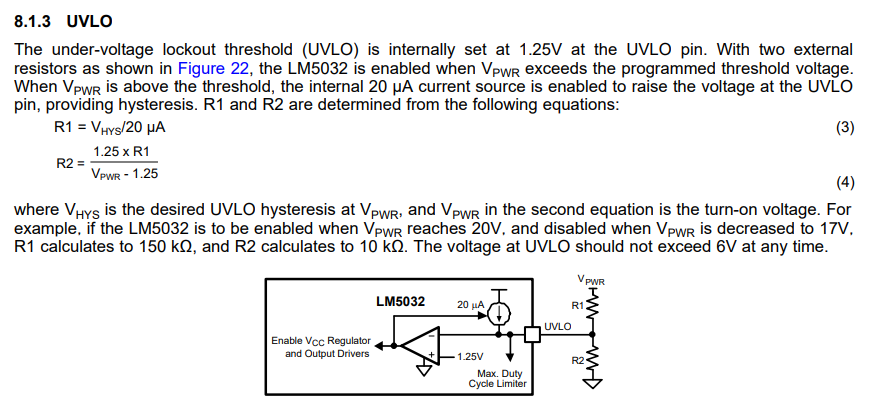
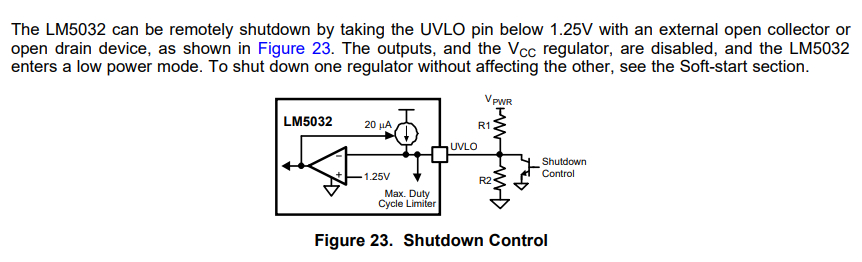
**Power Stage Calculations**

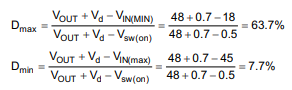
The battery voltage range is 2.5V to 3.65V per cell, 37.5V to 54.75V total, and the capacitor voltage will charge up to a bit less than that. To avoid extreme duty cycles, the converter should only be capable of 3:1 voltage step up, which still removes 86% of the capacitor’s stored energy. The output current is up to 190A.





Output current up to 190A with up to 3:1 voltage step-up, IIN = 190A \* 3 = 570A. Input voltage as low as 18V. Vout as high as 55V.

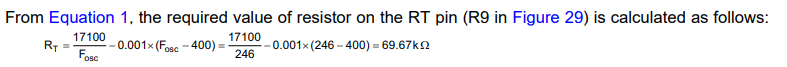
Switching frequency of 500kHz, interleaved to make it effectively 1MHz for the capacitors RLoad = VOut/IOut = 3.2\*15/190 = 0.25 ohms



Duty Cycle = 1 - VI/VO

DMin = 0

DMax = 1 - 18/55 = 67.5%



Peak IOut = 95\*2 = 190A

IL(avg) = ΔIL = (0.5 \* 190A) / (1 - 0.675) = 292.3A

I(Peak) = 292.3 + (58.1 / 2) = 320A

LMin = (18V \* 0.675) / (500000Hz \* 58.1A) = 0.412 uH

A diagram of a duty cycle

Description automatically generated

ICap-RMS = 0.7\*190A = 133A

A diagram of a complex

Description automatically generated

Use 4 x 10uF capacitors, X7R loses 10% of capacitance at 1 MHz, DF = 2.5%

ESR = DF/(2π\*f\*C) = 0.025/(2\*3.14\*9) = 0.442 mΩ

PCap = (133/4)^2\*0.000442Ω = 0.489 W

ΔVOut = (190A \* 1)/(10^-6 \* 4 \* 10 \* 500000 \* 2) + (320 \* 0.000442 Ω) / 4 = 4.79V

A diagram of a duty cycle

Description automatically generated

IN = 54 / (0.47 \* 0.5) = 230A

IRipple = 0.35 \* IN = 0.35 \* 230A = 80.5A

Again, use 4 x 10uF

PCap = (80.5A / 4)^2 \* 0.000442Ω = 0.179 W

PFET = 190A / (2 \* (1 - 0.673)) \* 0.0011 \* 0.673 \* 1.3 + 12 \* 0.178 \* 0.5 = 1.35 W

