Power Supply Stability Analysis

The wide range in small-signal output resistance makes compensation of the boost converter challenging.

For a simple voltage divider feedback with a minimum phase margin of 50 degrees over the load resistance range, the bandwidth for the high load resistance case was ~600 Hz. This corresponds to ~20V overshoot for a 10 mA step, which is a bit higher than I’d like.

﻿Voltage Divider R1: 5000.0

Voltage Divider R2: 355000.0

### Maximum Rload ###

Crossover Frequency: 603.643850607587

Phase Margin: 89.53007430355954

### Minimum Rload ###

Crossover Frequency: 18891.927762076644

Phase Margin: 52.145191270698845

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Adding a lead compensator (zero frequency < pole frequency) near the lowest pole frequency of the converter itself extends the bandwidth of the feedback loop. However, we have to reduce the gain of the error amplifier to make sure the error amplifier poles don’t cause any issues. The gain of the lead compensator is chosen to put at most ¼ Vout over the capacitor, allowing us to use common 100V capacitors. Lastly, an integrator is placed in the error amplifier feedback path to eliminate DC errors.

﻿Voltage Divider R1: 5000.0

Voltage Divider R2: 355000.0

Voltage Divider R2a: 340000.0

Voltage Divider R2b: 15000.0

Voltage Divider C2a: 93.62055475993844 nF

﻿Error Amplifier Rf (series): 22000.0

Error Amplifier Cf (series): 22.0 nF

### Maximum Rload ###

Crossover Frequency: 1333.8669479535445

Phase Margin: 80.50769880169565

### Minimum Rload ###

Crossover Frequency: 49189.13516317414

Phase Margin: 58.08831512340727

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