

Designing a Low-Dropout Regulator for higher voltage SiPMs

Salome Tvauri



Motivation



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

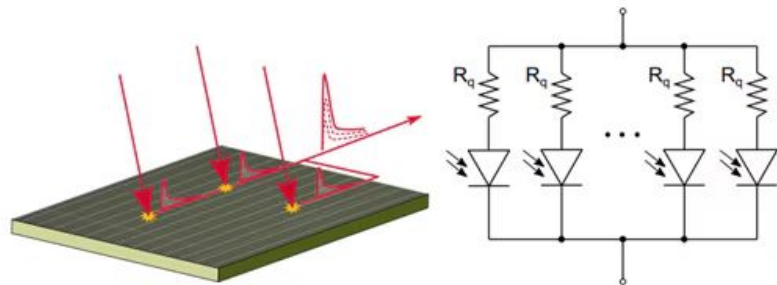
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Development of a multi-channel power supply for silicon photomultipliers reading out inorganic scintillators

O. Javakhishvili ^{a,b}, I. Keshelashvili ^a, D. Mchedlishvili ^{c,d,*}, M. Gagoshidze ^b, T. Hahnrahts ^a, A. Kacharava ^a, Z. Metreveli ^b, F. Müller ^a, T. Sefzick ^a, D. Shergelashvili ^d, H. Soltner ^e, H. Ströher ^a, for the JEDI collaboration

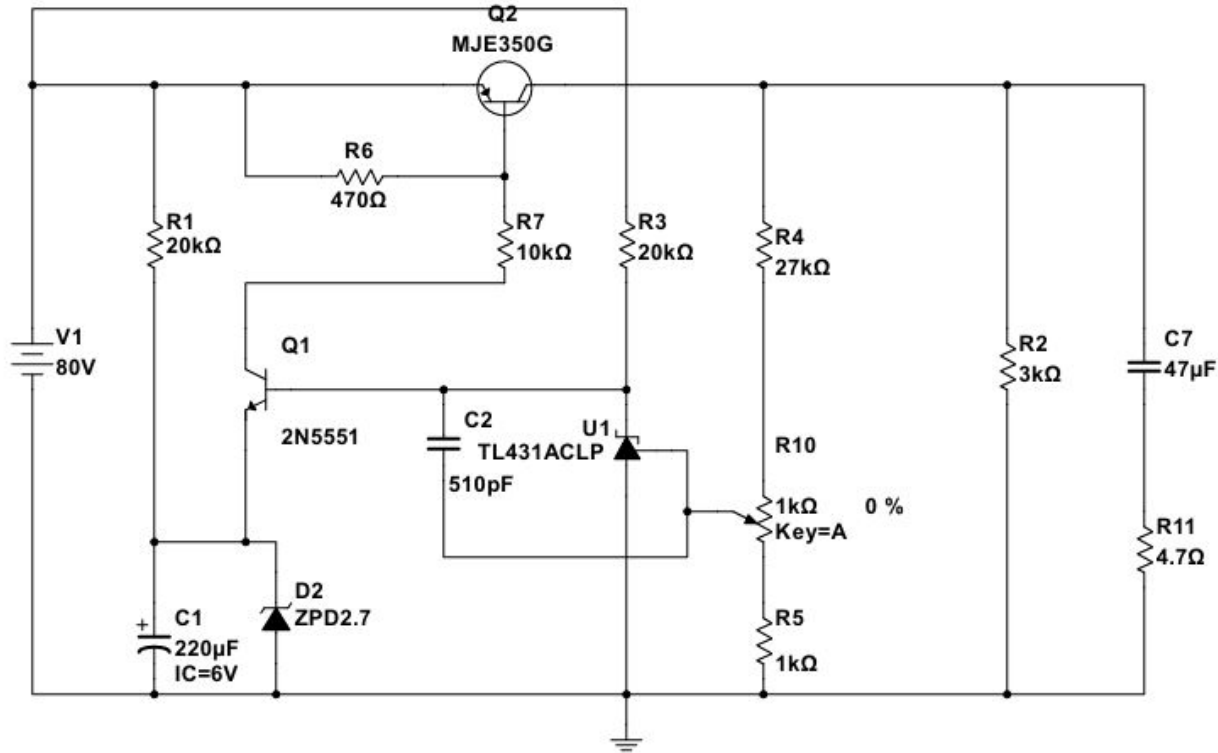


Imposed Requirements

- ❖ **Linearly Regulated (Low-Noise / Minimum Noise)**
- ❖ **Output Voltage Range: 35–70 V**
- ❖ **Output Current: Limited to 50 mA**
- ❖ **Controllable Output Ramp-Up / Ramp-Down**
- ❖ **Input Voltage: ~ 80 V (Requires a pre-regulator)**

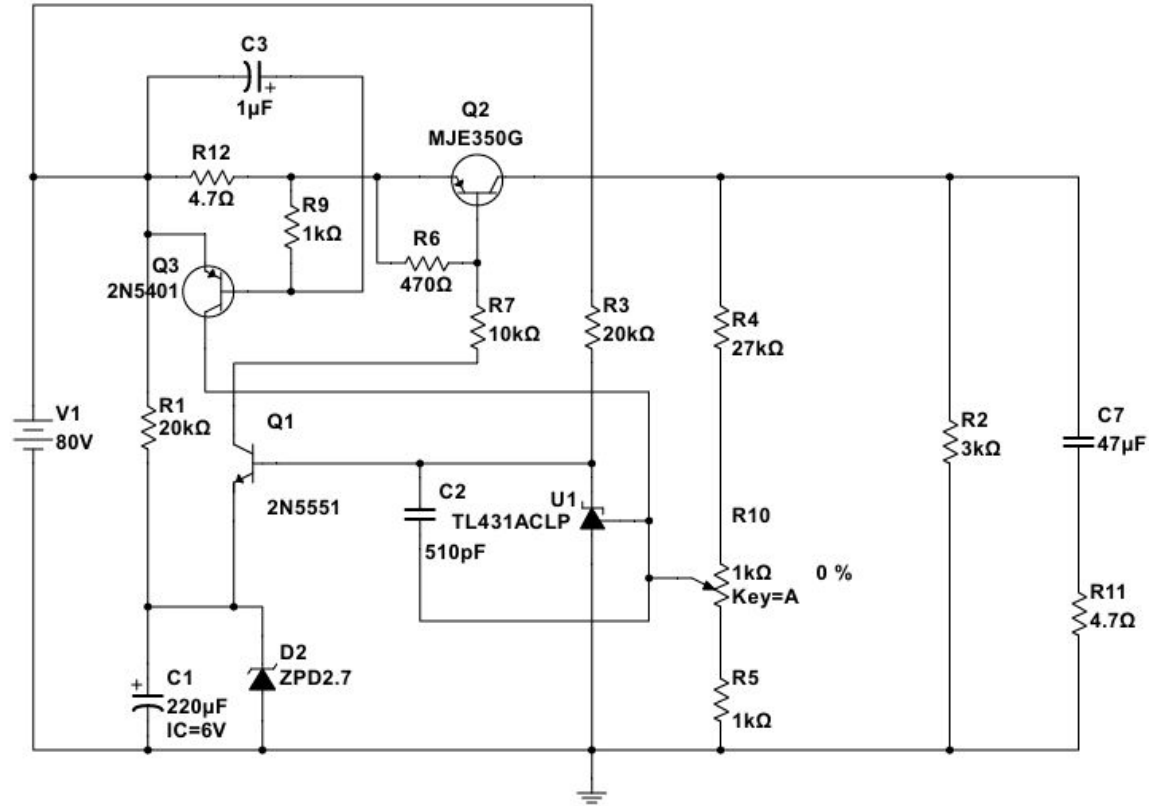


Main Regulator

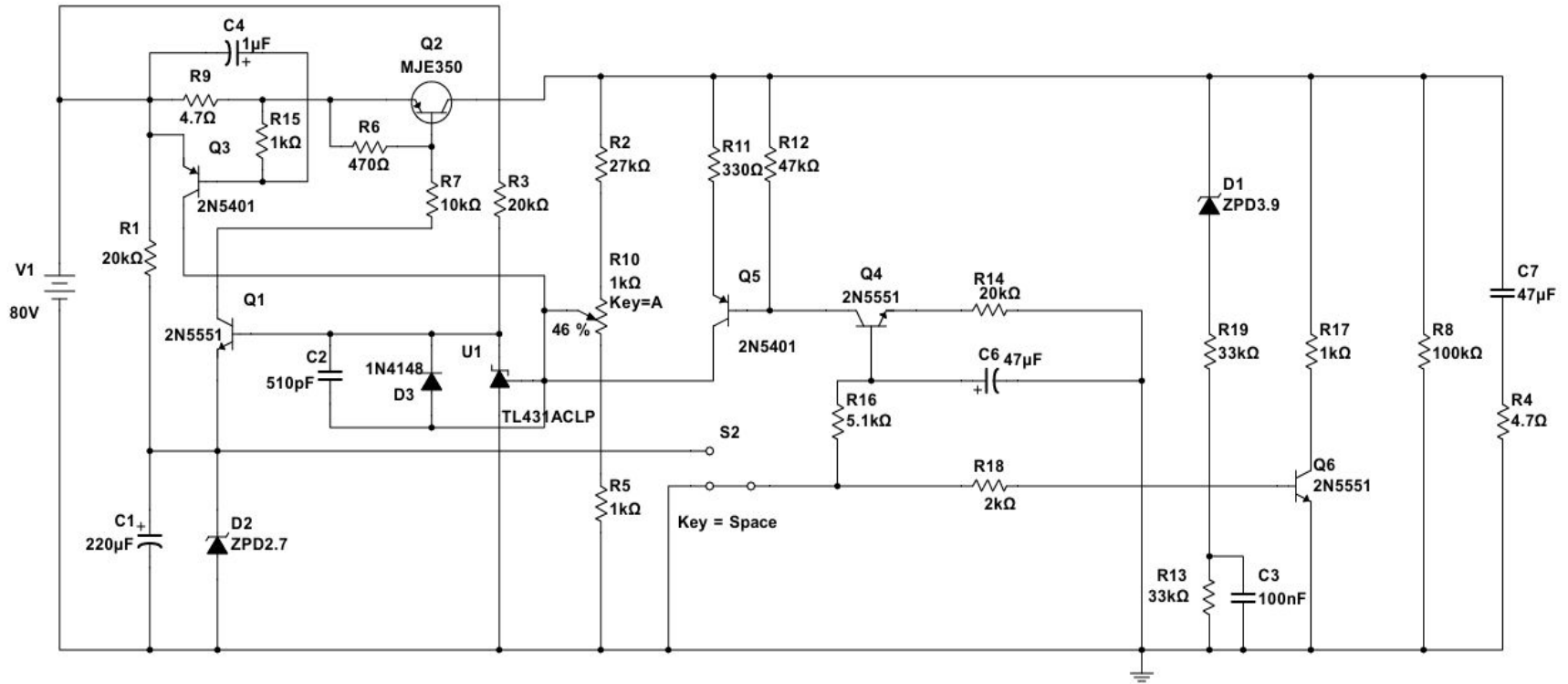


Designed in NI Multisim

Current Limiting

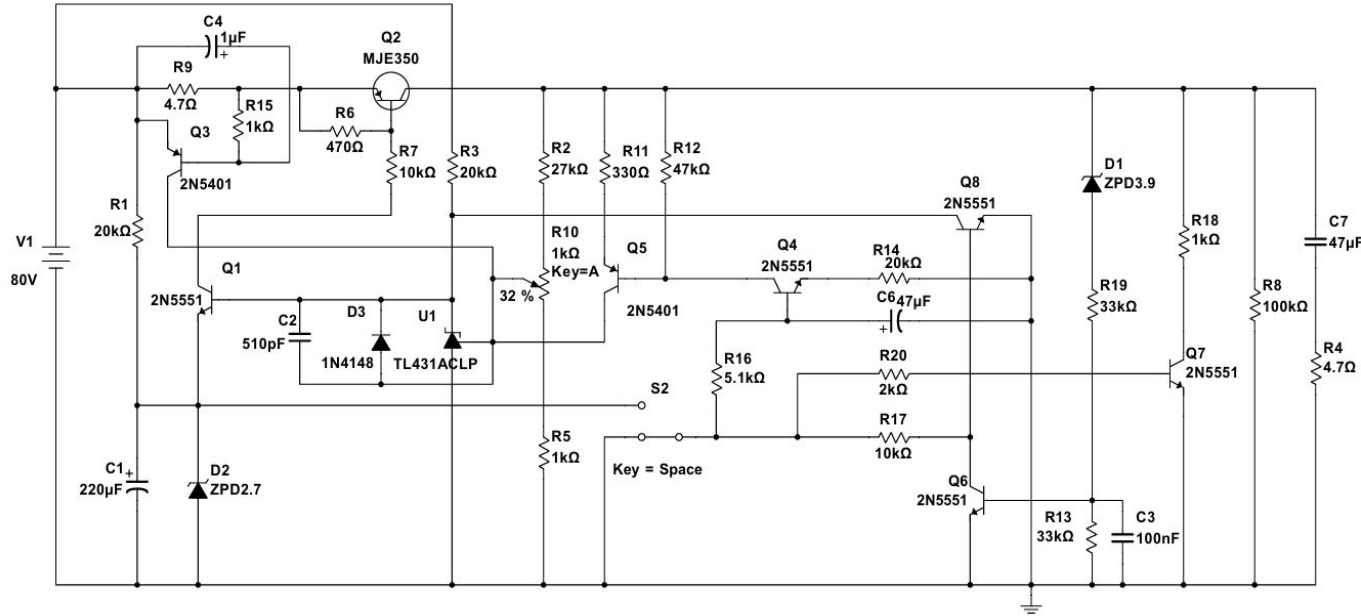


Ramp up/down



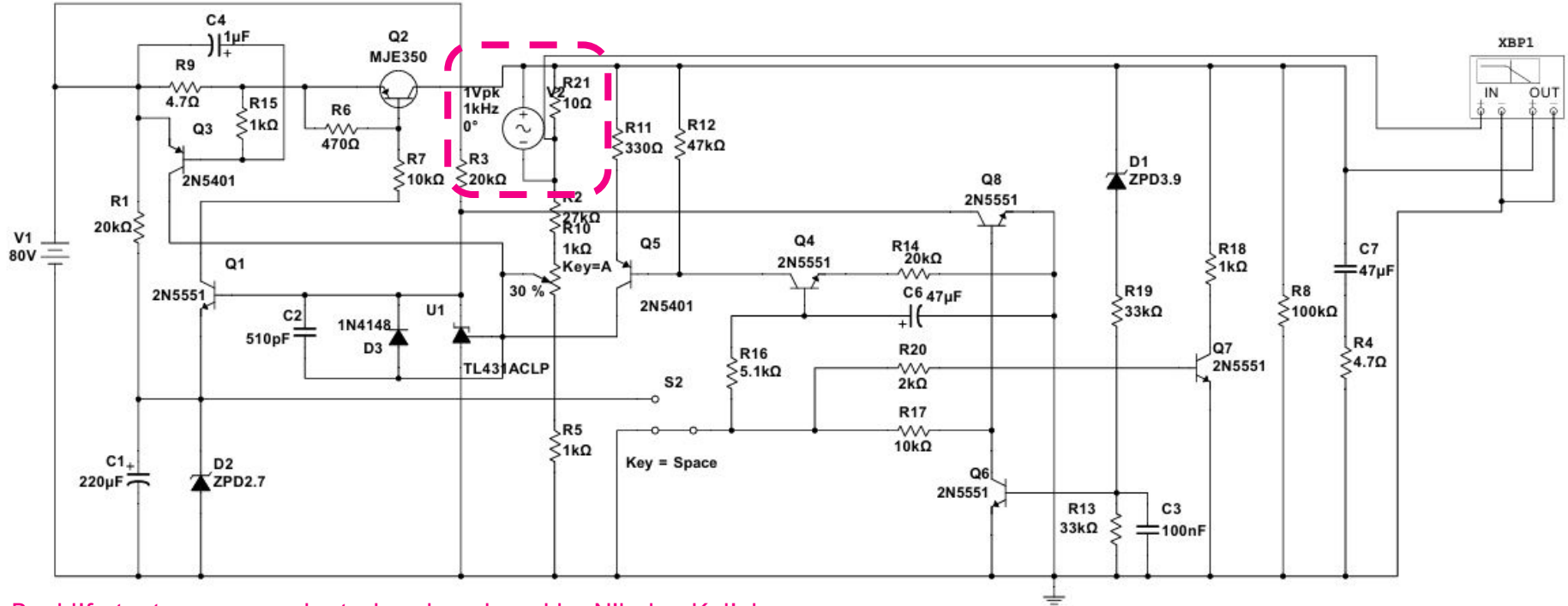
Complete power supply circuit

First prototype



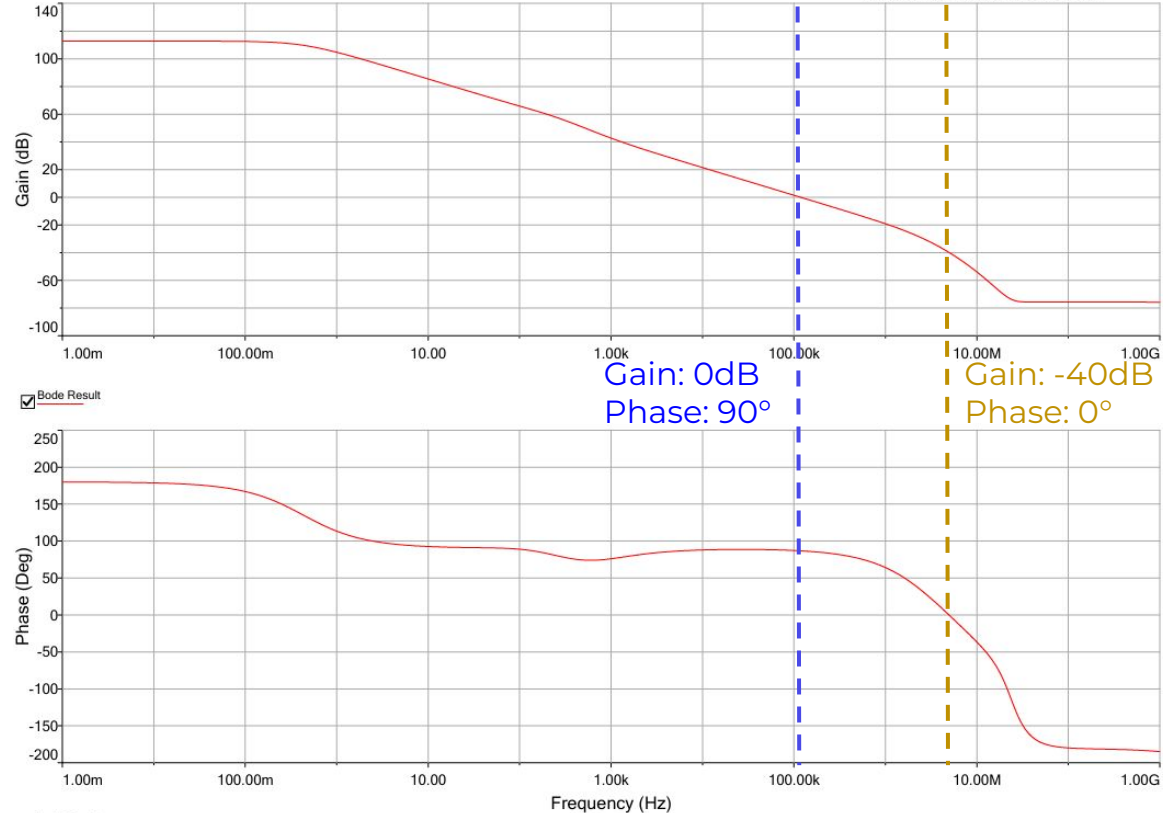
- ★ U1 - Voltage reference
- ★ Q1, Q2 - Main regulation
- ★ Q3 - Current limiter
- ★ Q4, Q5 - Ramping circuit
- ★ Q7 - Output discharge
- ★ Q6, Q8 - Output shutoff

Feedback stability



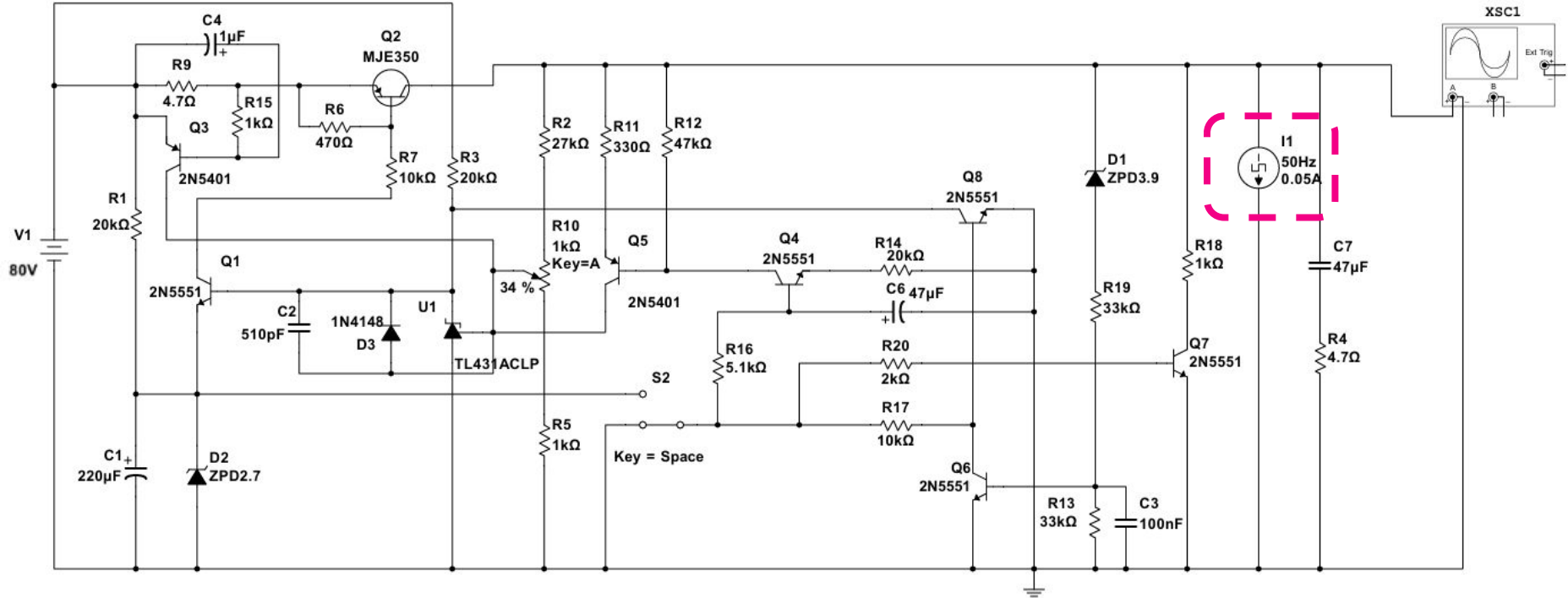
Real life tests were conducted and analyzed by Nikoloz Kalichava

Feedback stability

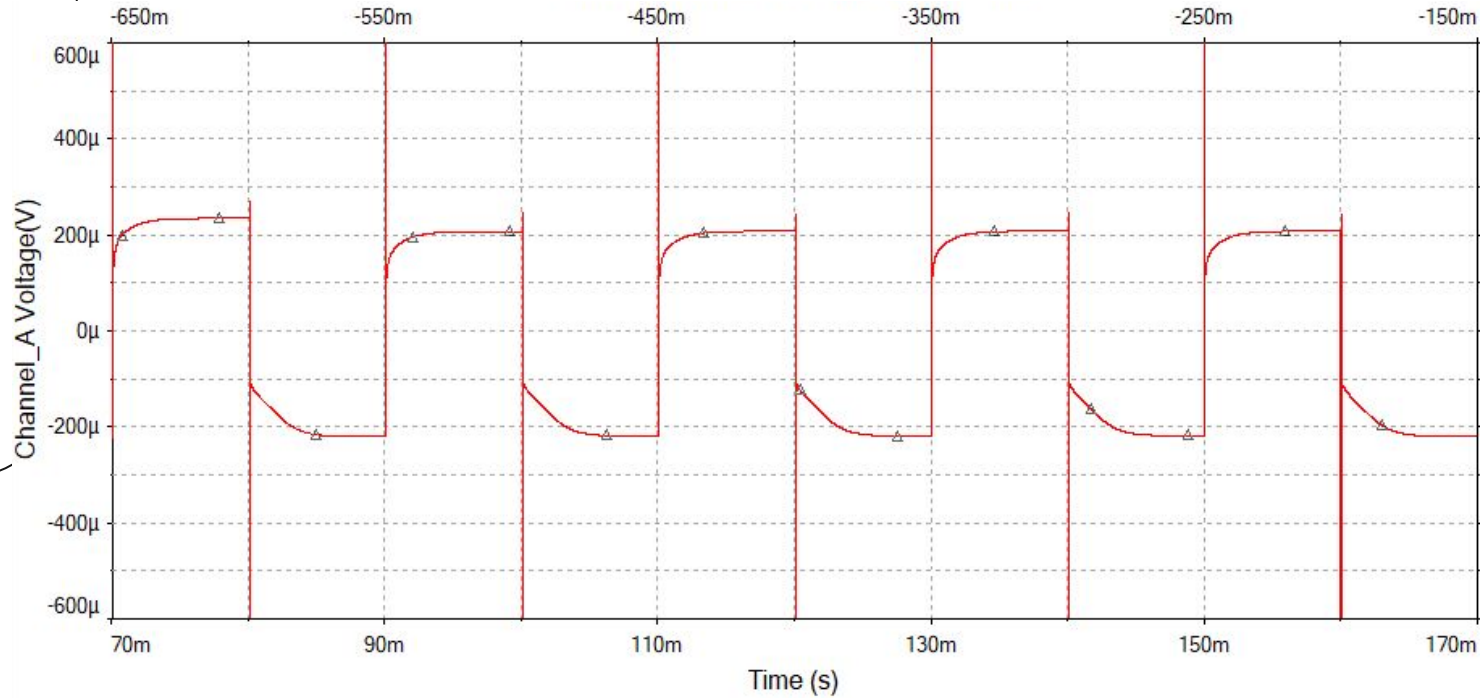


Simulated in NI Multisim

Load Regulation

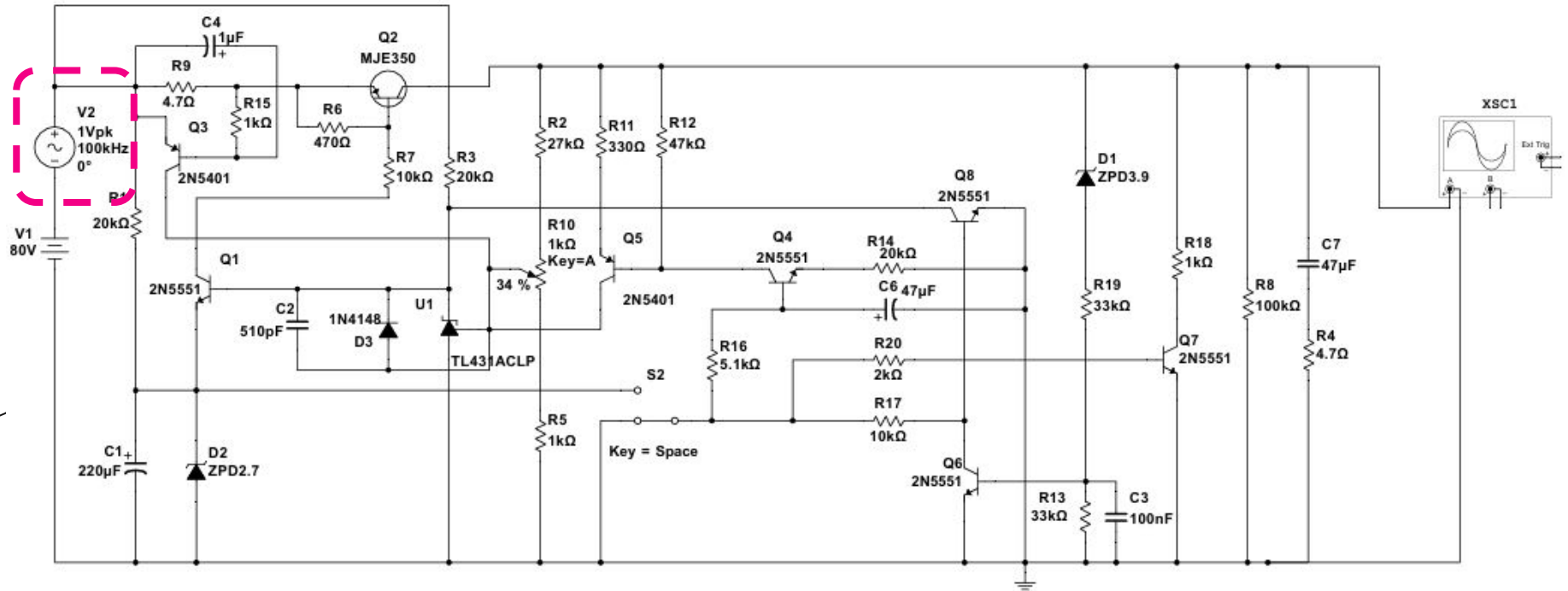


Load Regulation



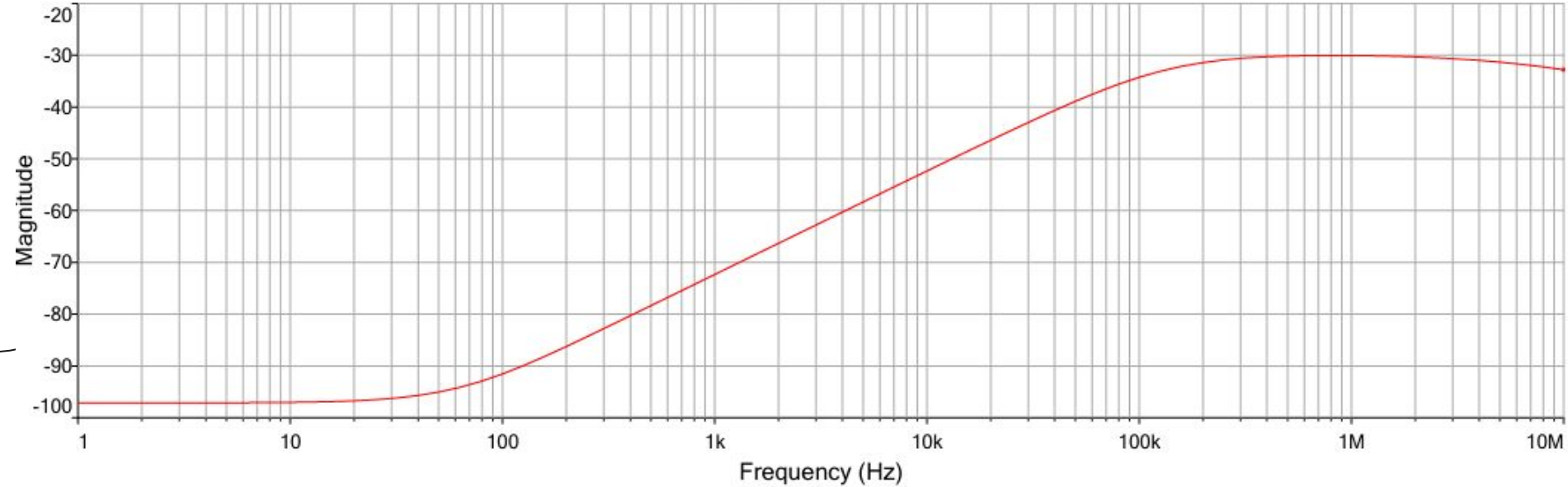
V_{out} = 54v
Δv = 425 μv
I = 50 ma
K = Δv/V_{out}
=8ppm
Spikes = 0.8%

Power Supply Rejection Ratio (PSRR)

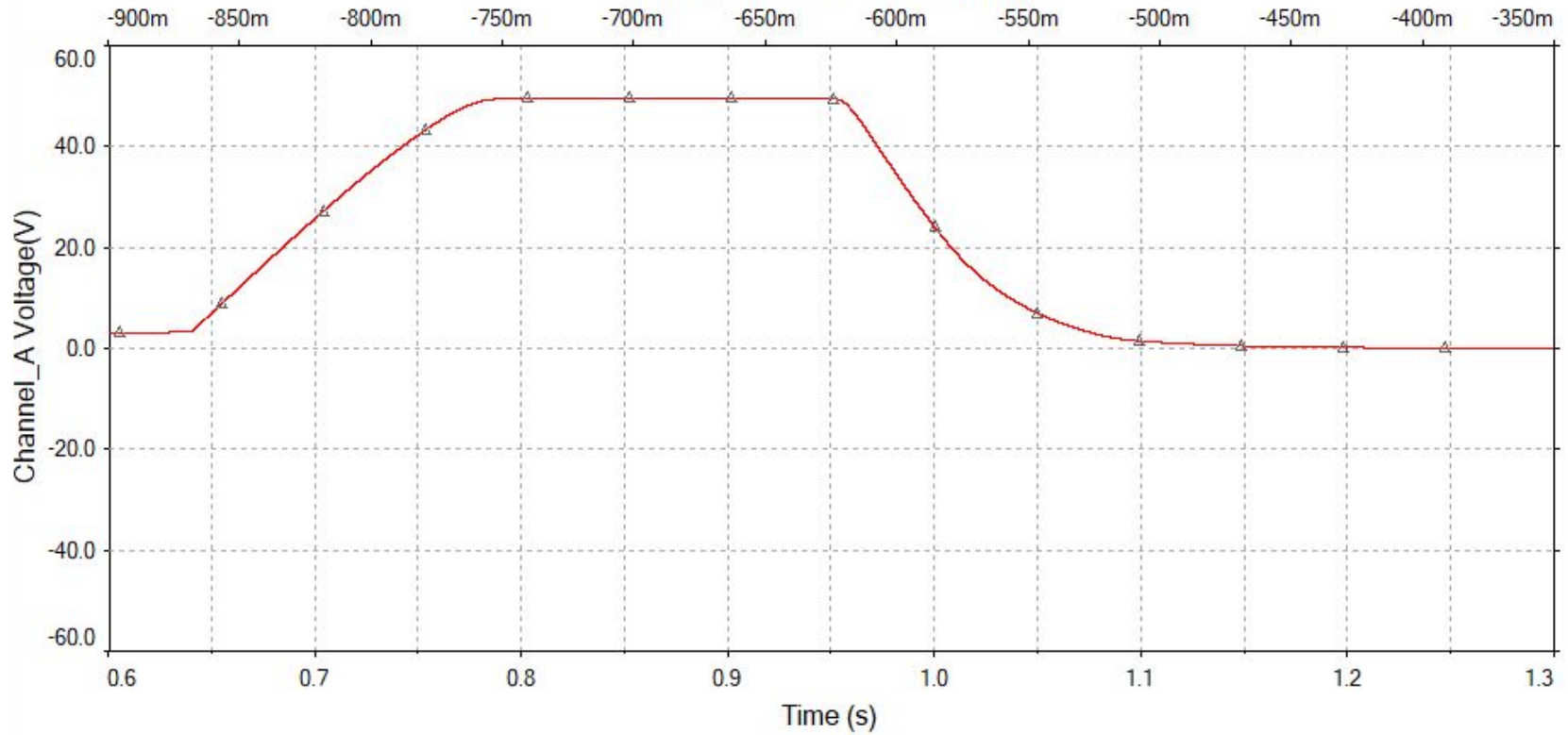


Power Supply Rejection Ratio

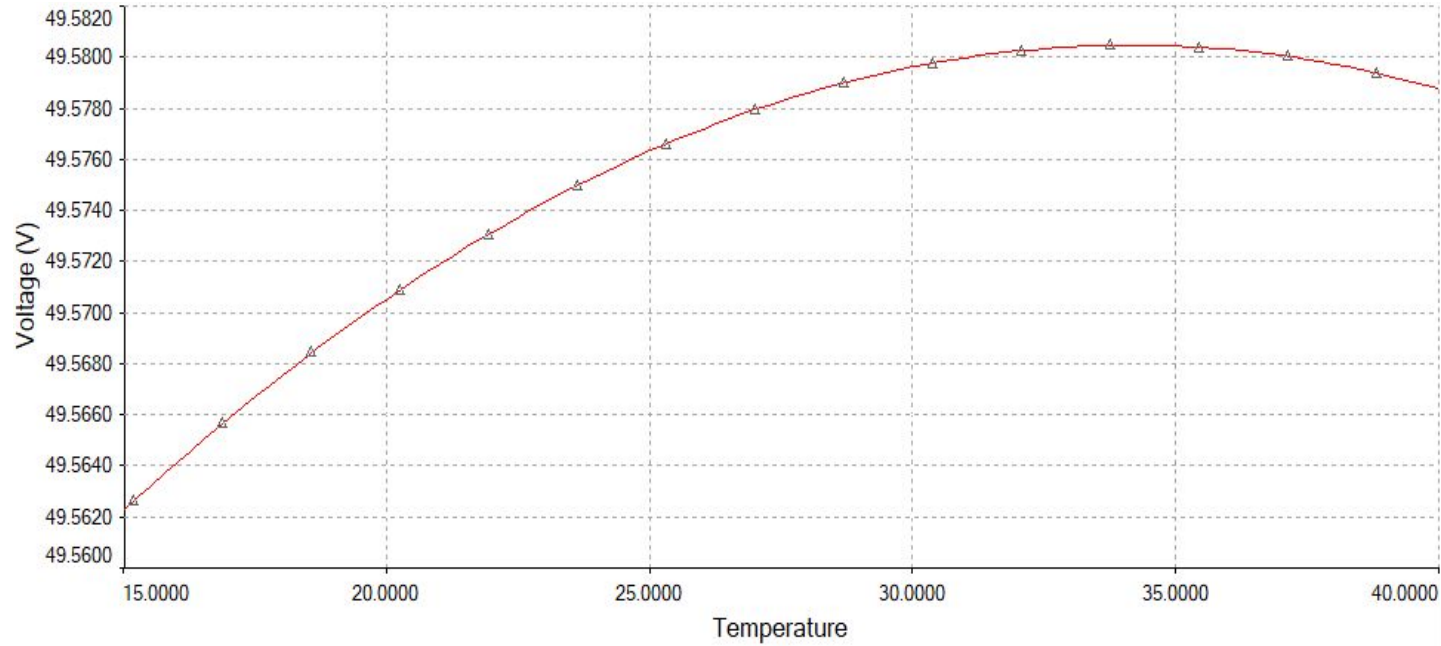
$K(100\text{Hz}) \geq -90\text{dB}$



Power Supply Enable / Disable



Voltage Dependence on Temperature



$$\Delta v = 18 \partial_3$$

Also tested in lab environment using thermostatic chamber



Thank you!

Salome Tvauri

