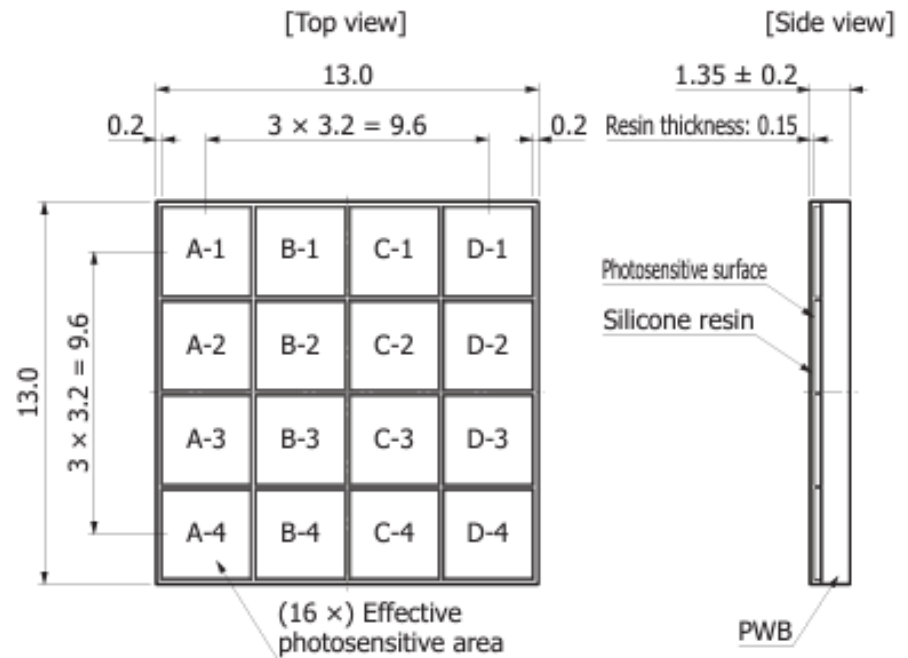


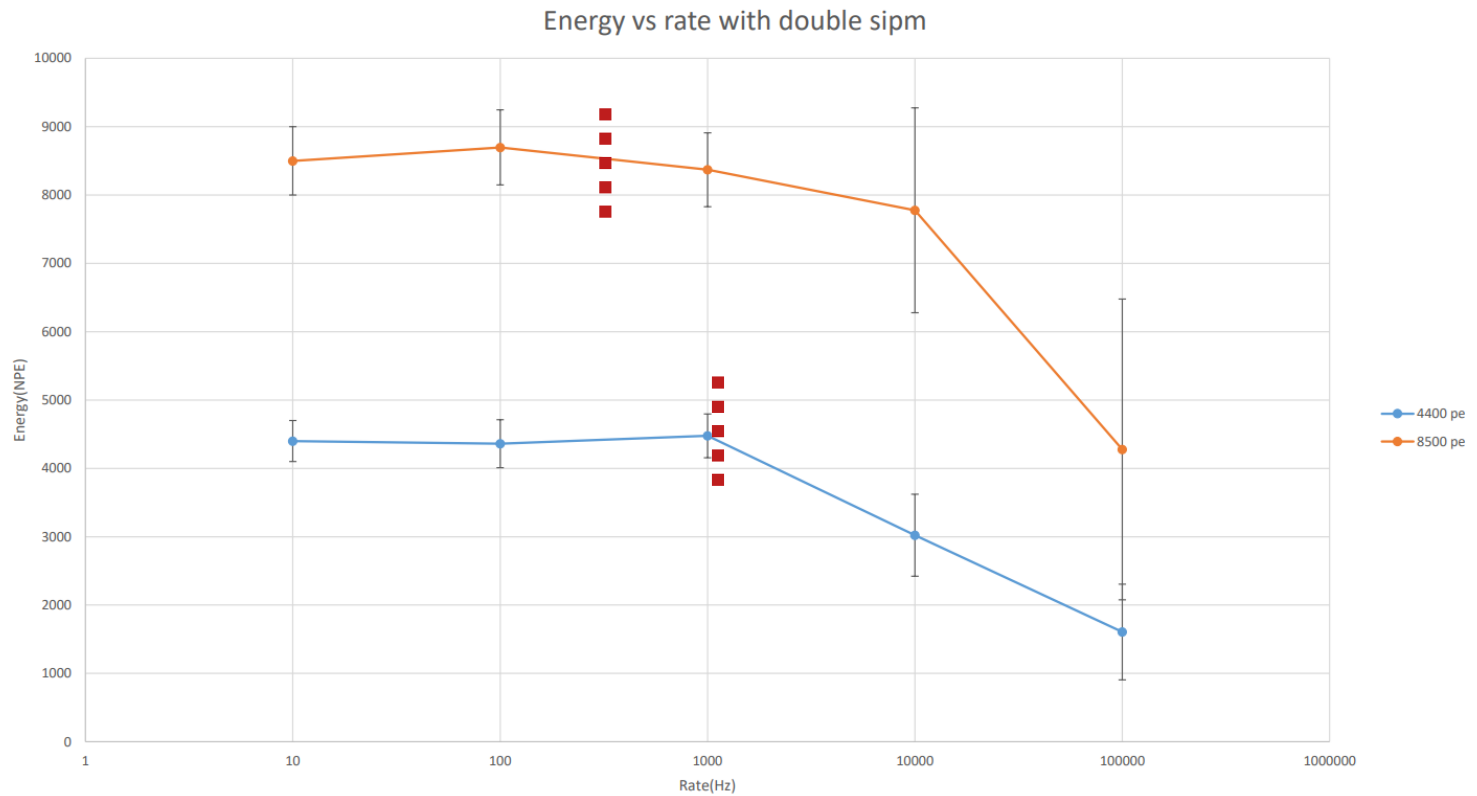
# SiPM Gain Non-Linearity Evaluation



Steve Titus

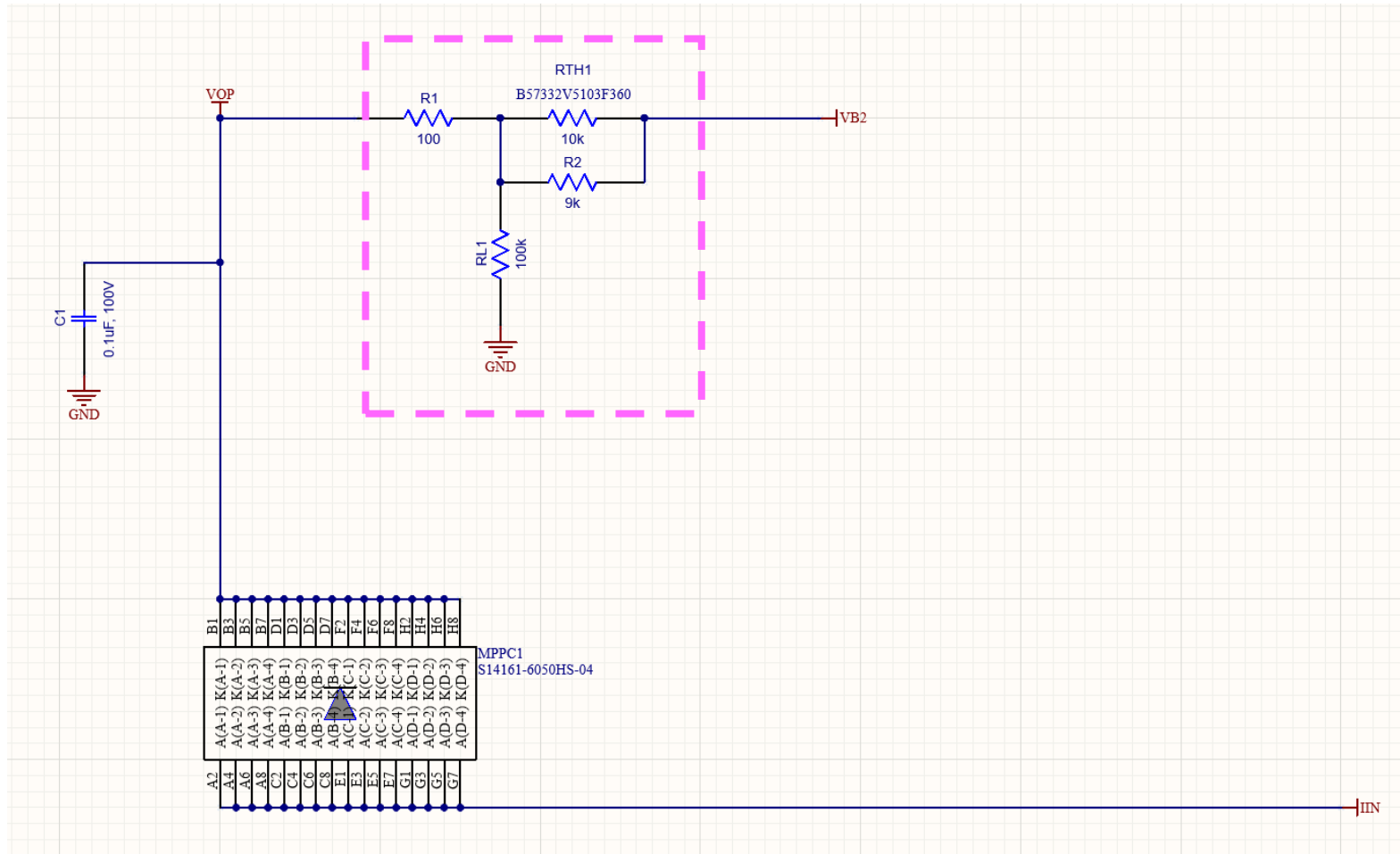
Friday, October 20, 2023

# Issue



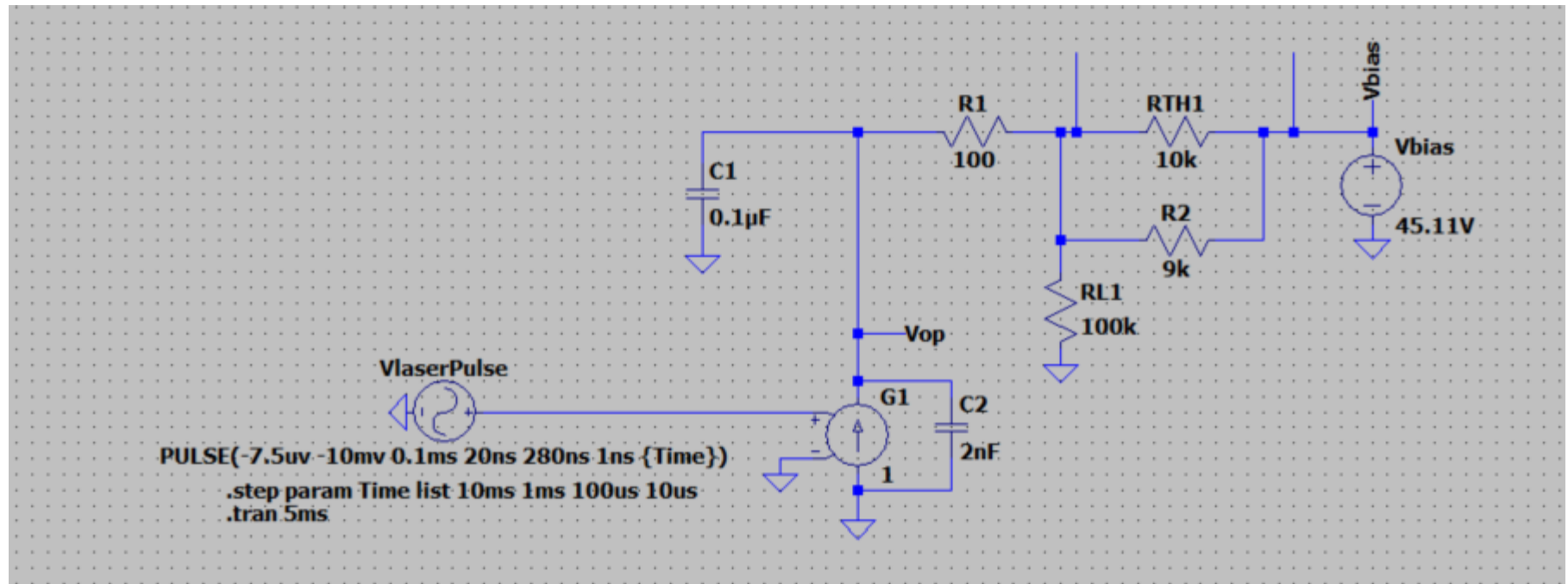
- Issue – Non-linear Gain
  - Corner Frequency near 1kHz

# Root Cause



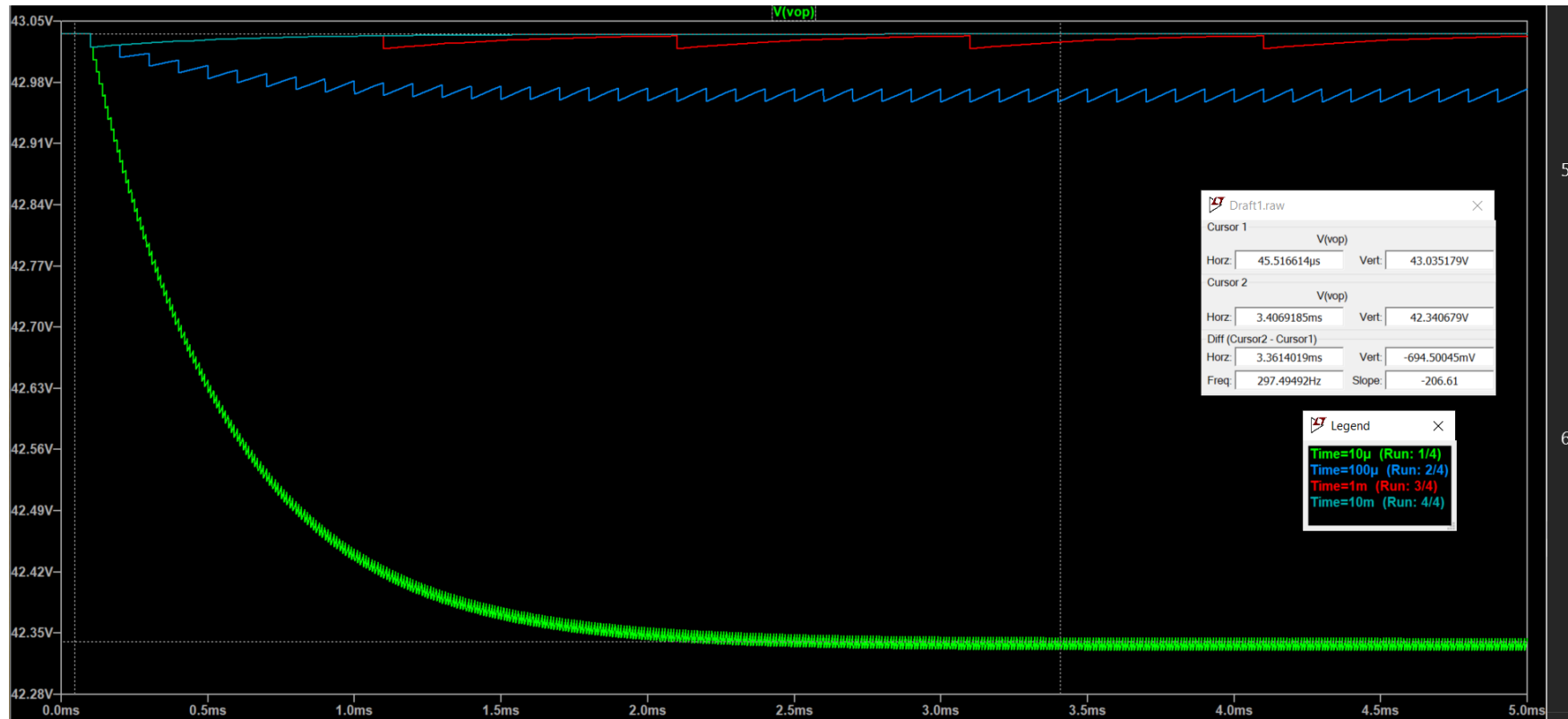
- Assumed Root Cause: Corner frequency caused by high impedance in the temperature correction circuit

# Simulation Schematic



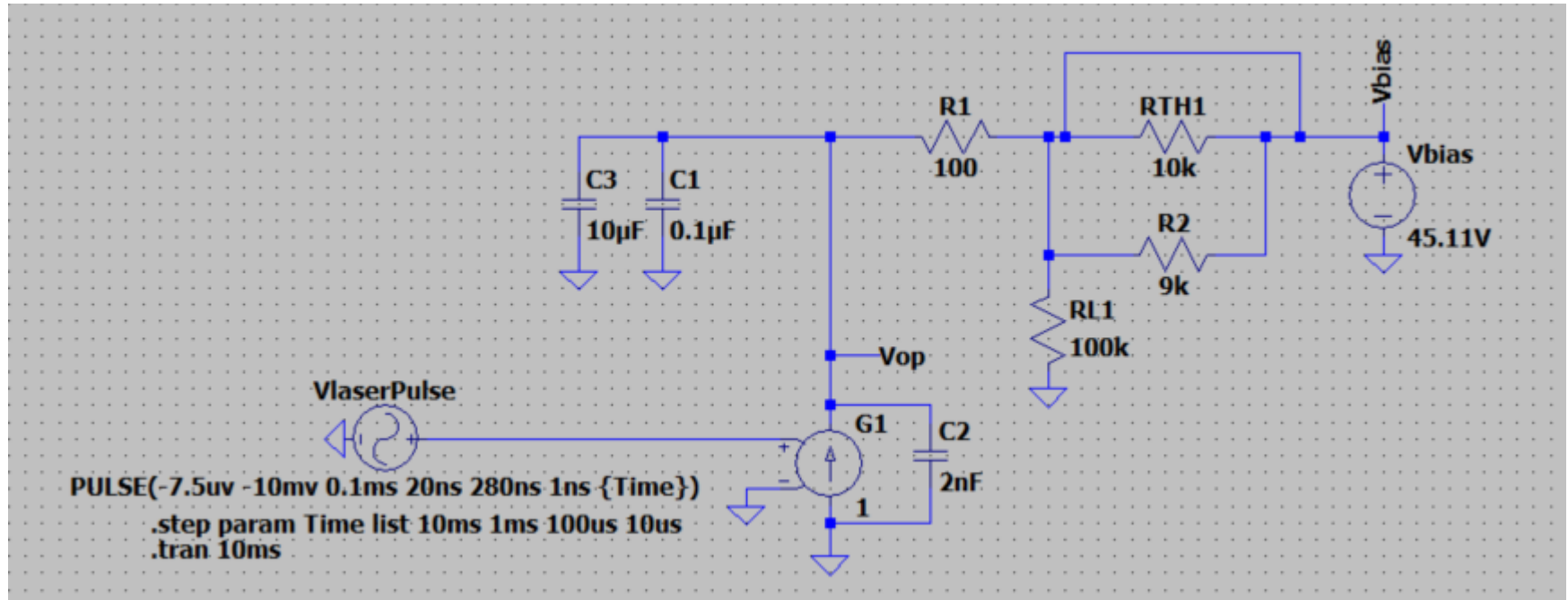
- Pulsed current source used as a simplified model for a SiPM with laser input.
- 10mA pulses, 300ns asymmetric ramp pulse to approximate SiPM signal
- Varying Rates 100Hz to 100kHz
- Measurements taken at Vop

# Simulation Results



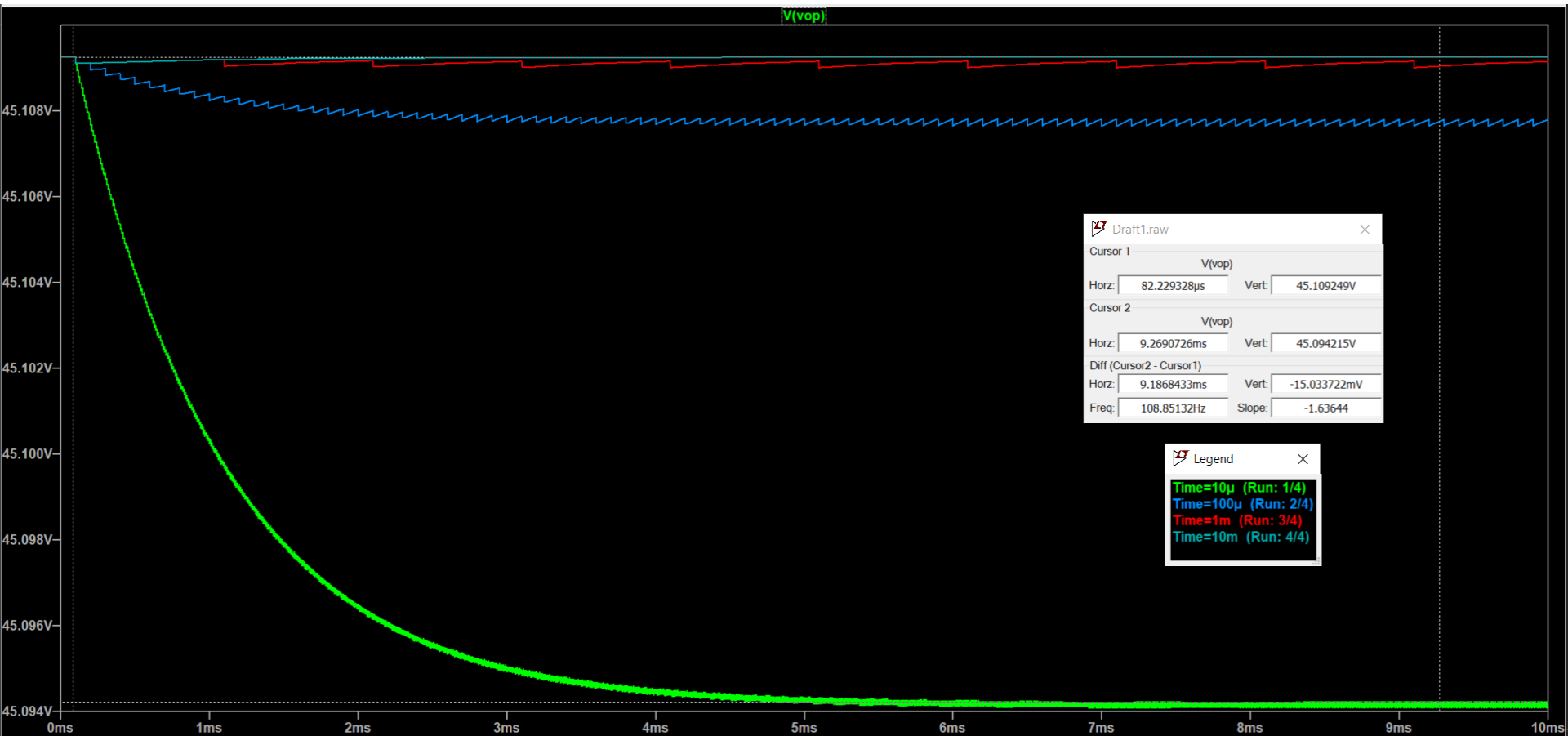
- As pulse rate increases  $V_{op}$  decreases
- $V_{op}$  drop of ~694mV at 100kHz

# Simulation Circuit Modified



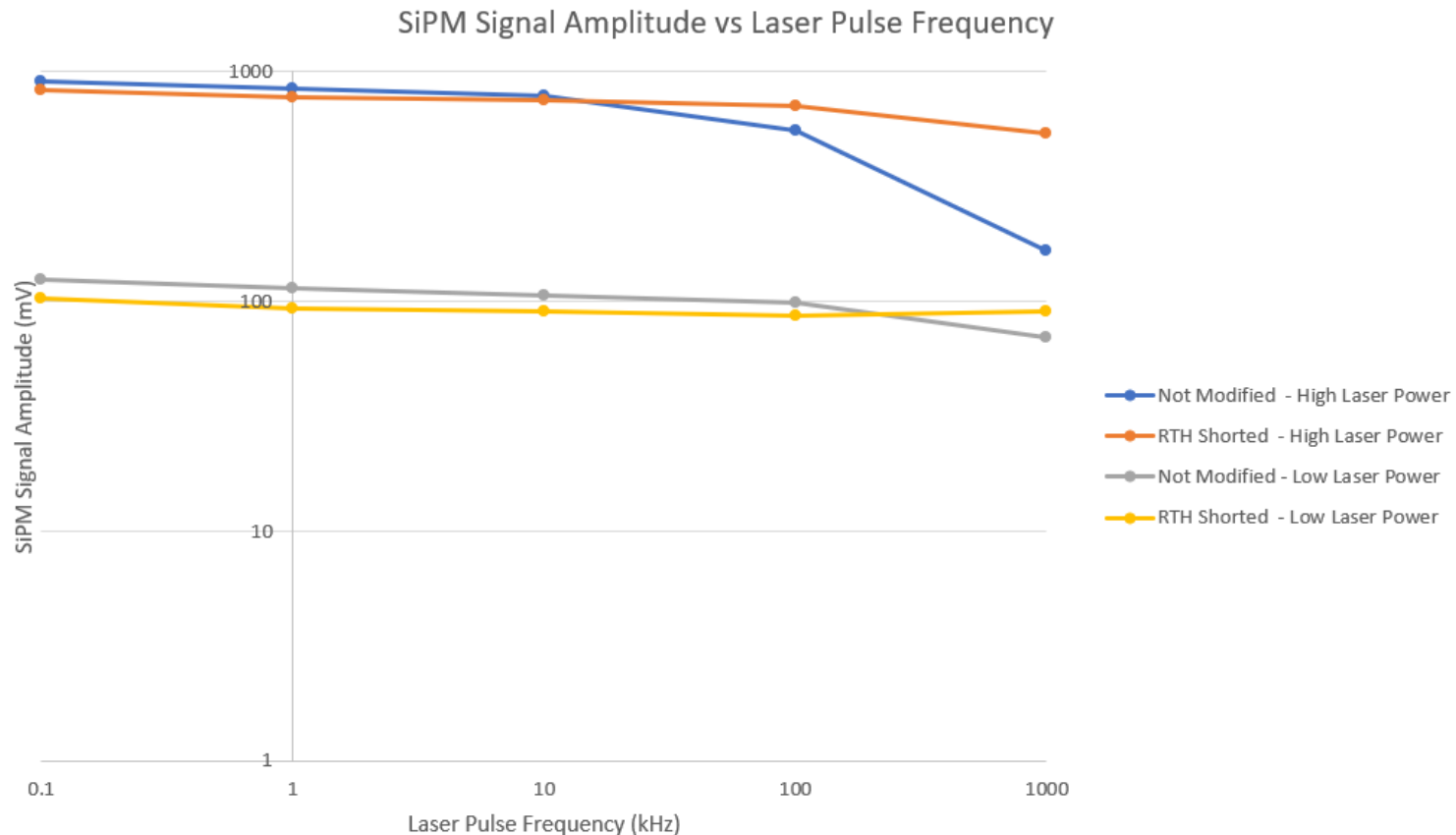
- Thermistor (RTH1) shorted to minimize impedance
- Bulk Capacitance added (C3) to supply high-frequency current draw

# Simulation Results



- Original circuit: Vop drop of ~694mV at 100kHz
- Modified circuit: Vop drop of ~15mV at 100kHz

# Experimental Results with S14160-6050HS (4x4 SiPM)



- Thermistor was removed from the circuit as in the simulation
- Higher capacitors were not available for testing due to voltage rating
- High power 58.5% laser power ~9600 pe
- Low power 58.5% laser power with N.D. filter with O.D. of 1.0



# Summary

- Gain can be linearized by reducing input impedance and increasing bulk capacitance

