EPS Recruitment Challenges
I.
Background

MOSFETs are commonly employed as load switches in satellite systems and for general-purpose electronic switching. High-side switching in this context is achieved using PMOS devices, which must be individually controlled by the onboard microcontroller to enable or disable specific loads as needed, particularly during subsystem failures or other fault scenarios.

The specific MOSFETs selected for this design are listed below:

Problem Statement

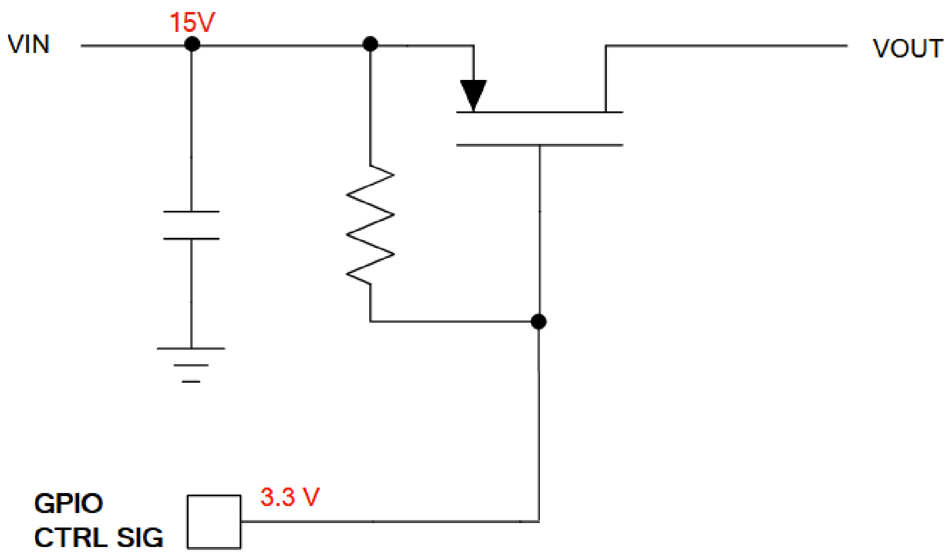
Using the following MOSFET devices:

- Vishay SI2301BDS (P-Channel)
- Vishay SI2302CDS (N-Channel)

Two different power switching circuits were devised:

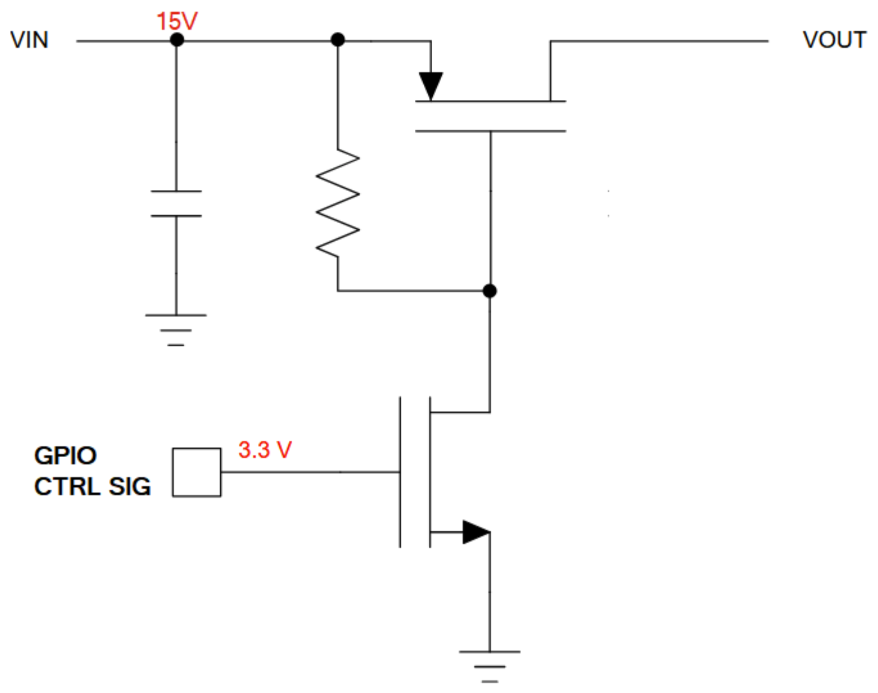
Part 1

The voltage measured at Vout is stuck at 15V regardless of the control signal state.



Part 2

Additional modifications were made, but the load-driving MOSFET keeps burning out.



Questions:

Individual questions can be attempted.

- **Figure out the issue with the first circuit.**
- **Explain why the second circuit is preferred over the first.**
- **Discuss why the second circuit works in simulation but fails in the real world.**
- **Find as many issues as you can in this circuit and better MOSET driving practices.**

Tools you may find useful: LTSpice, Falstad Circuit Simulator,Tinker CAD, Any other Spice simulation tool.

Good Luck!

II.
Background

Satellites rely on multiple sensitive sensors to estimate their position and orientation accurately. One such critical sensor is the magnetometer, which measures the Earth's magnetic field to assess satellite movement and attitude.
AMR Magnetometers output a differential voltage signal proportional to the magnetic field strength. This differential signal is very small - on the order of a few millivolts (±2 mV range).

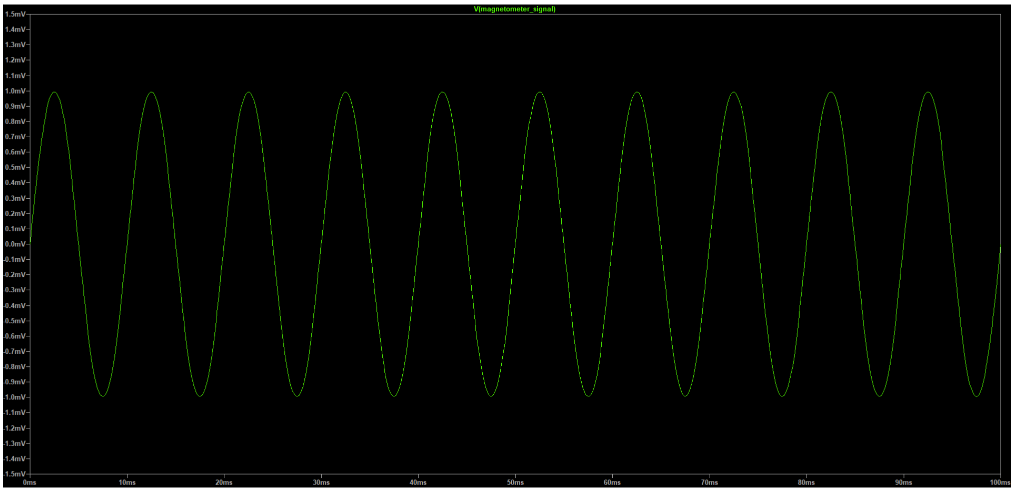
This analog signal must be fed to an ADC on board, which digitizes the analog voltage for processing by the satellite's microcontroller. However, feeding the raw magnetometer output directly into the ADC causes significant issues due to the low amplitude of the signal relative to the ADC's input range, leading to poor resolution and data loss.

Problem Statement

Design a low-power, reliable signal conditioning circuit that:

- Amplifies the ±2 mV differential signal from the magnetometer to fully utilize the ADC input range.
- The ADC has a differential full-scale input range of ±2.048 V.
- The on-board power supply voltage available is 3.3 V single supply.
- The conditioned signal must be compatible with the ADC input(either differential or single ended), ideally swinging close to full scale without clipping.

Sample Magnetometer Output



Your task is to design an analog signal conditioning circuit that amplifies and processes the magnetometer's differential output so it fits optimally within the ADC's input range, preserving signal integrity and maximizing measurement accuracy.

Tools you may find useful: LTSpice, Falstad Circuit Simulator,Tinker CAD, Any other Spice simulation tool.

Good Luck!