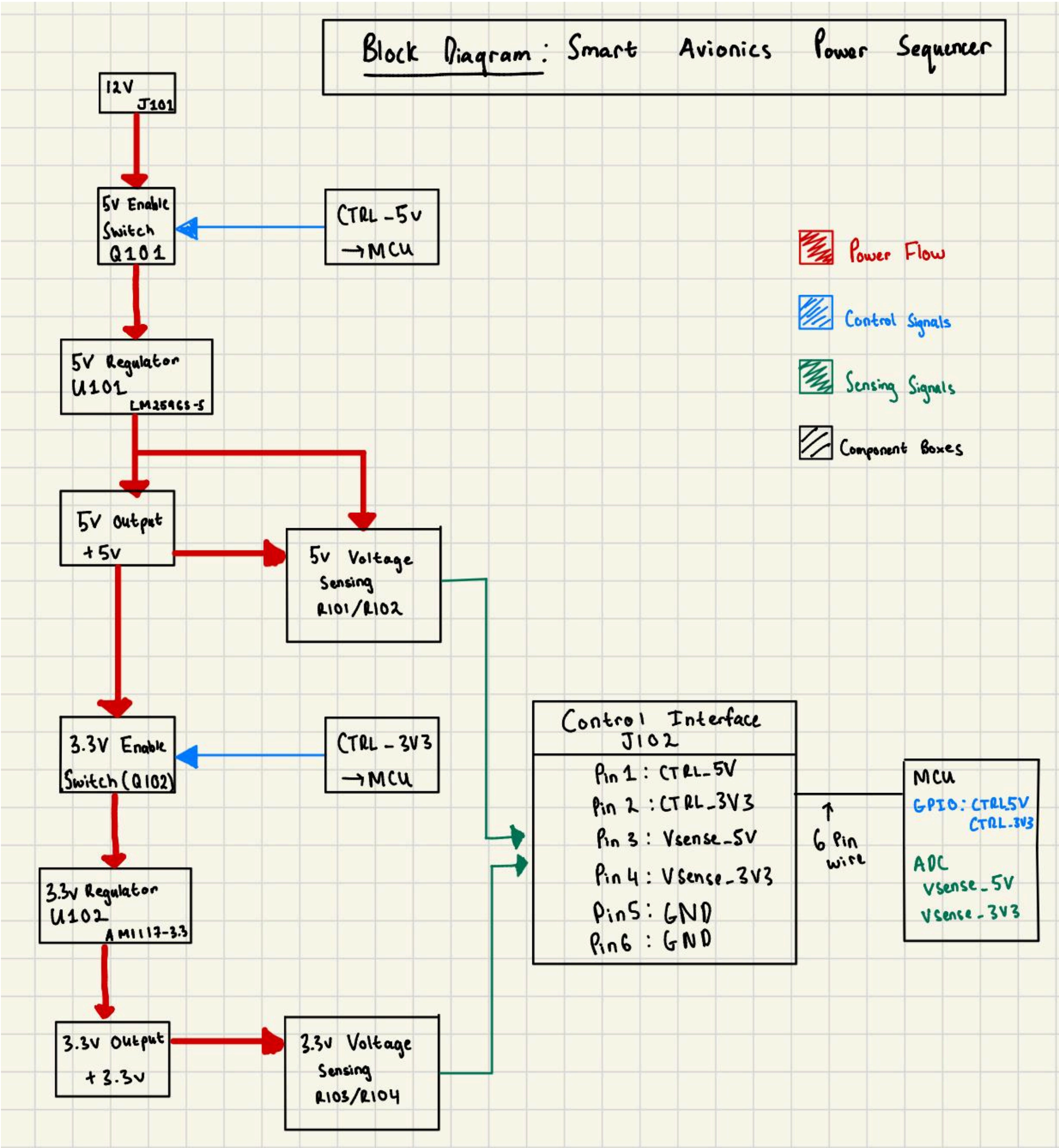
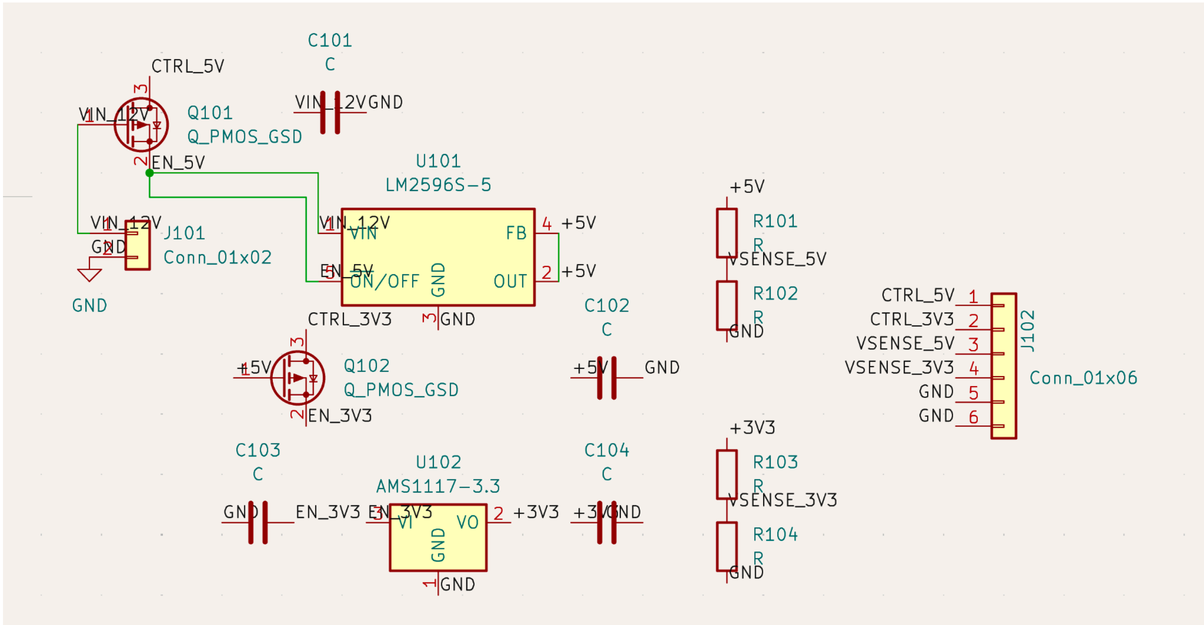


Block Diagram Description:

This block diagram illustrates an intelligent power management system for avionics and embedded applications. The system converts 12V input into independently controlled 5V and 3.3V rails using software-controlled MOSFET switches (Q101 and Q102). A microcontroller commands each rail on or off via digital signals (CTRL_5V and CTRL_3V3), while voltage sensing circuits (R101-R104) provide real-time feedback to ADC inputs for health monitoring and brownout detection. The control interface (J102) connects the power board to the microcontroller, enabling advanced features including sequenced startup, graceful shutdown, and fault detection, which are all critical capabilities for mission-critical aerospace and autonomous systems.



Schematic Description:

This schematic implements a dual-rail intelligent power distribution system with software-controlled sequencing and monitoring capabilities. The circuit accepts 12V input through connector J101 and employs a two-stage voltage regulation architecture: a high-efficiency LM2596S-5 buck converter (U101) generates the 5V rail, followed by an AMS1117-3.3 linear regulator (U102) that derives 3.3V from the 5V output. P-channel MOSFETs (Q101, Q102) control the enable pins of each regulator, allowing a microcontroller to independently activate or deactivate each rail through active-low control signals. Input and output capacitors (C101-C104) ensure stable operation and noise filtering. Voltage divider networks (R101-R104) scale the rail voltages to safe levels for ADC monitoring, providing real-time telemetry of power system health. The six-pin control header (J102) interfaces all control and sensing signals to an external microcontroller, creating a complete closed-loop power management system.

Smart Power Sequencer & Fault Manager

Purpose

This project simulates a software controlled power system similar to those used in avionics and embedded systems. The goal was to build a clean and testable program that turns power rails on in the correct order, checks that they are operating correctly, and safely handles failures.

The focus of the project is software design and reliability rather than hardware manufacturing.

What the Program Does

The system controls two power rails, 5V and 3.3V, using a simple state machine.

1. Starts in an OFF state
2. Enables the 5V rail and checks that it reaches a valid voltage
3. Enables the 3.3V rail and checks that it reaches a valid voltage
4. Enters a RUNNING state if all checks pass
5. Detects issues such as low voltage or failed startup
6. Safely shuts down and reports a fault when errors occur

All behavior is deterministic and rule based.

Software Design

- The logic is implemented as a finite state machine with clear states and transitions
- A hardware abstraction layer separates control logic from hardware behavior
- A simulated hardware module allows voltage ramps noise and failures to be tested
- Retry limits and safe shutdown logic are included

Testing

The program includes test scenarios for normal startup slow or failed power rails runtime brownouts and noisy voltage readings. Each test verifies correct state transitions and fault handling.

Tools and Concepts

- Python
- State machines
- Logging and debugging
- Fault handling and retries
- Testable system design

Result

This project demonstrates the ability to design reliable and testable software that interacts with hardware like systems. It shows experience with state machines fault handling and clean program structure which are transferable to systems and backend software roles.