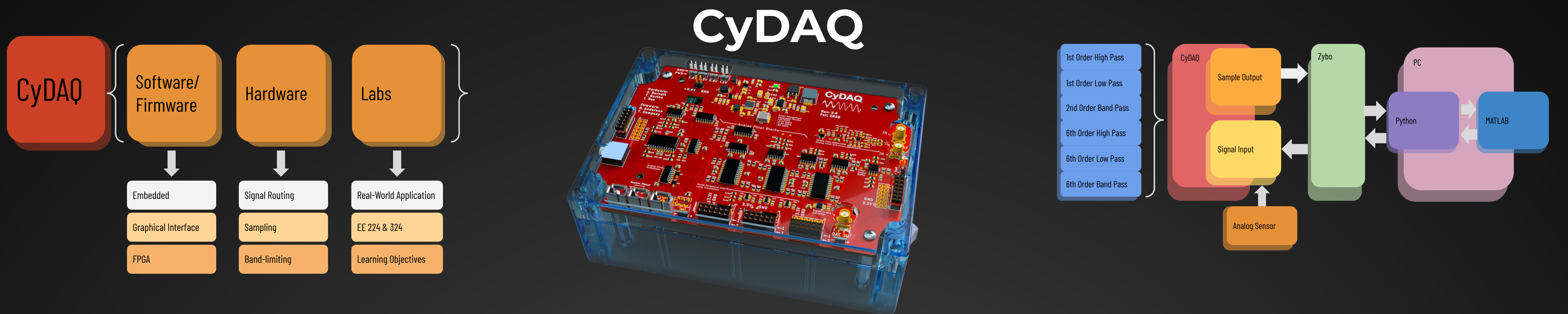


Introduction of Real-World Signals and Systems into ECpE DSP Laboratory Curriculum

Team: SDDEC20-14 Advisor & Client: Matthew Post

Members: Brady Anderson, Sam Burnett, Mitchell Hoppe, Emily LaGrant, Max Kiley and Isaac Rex



Our Goals:

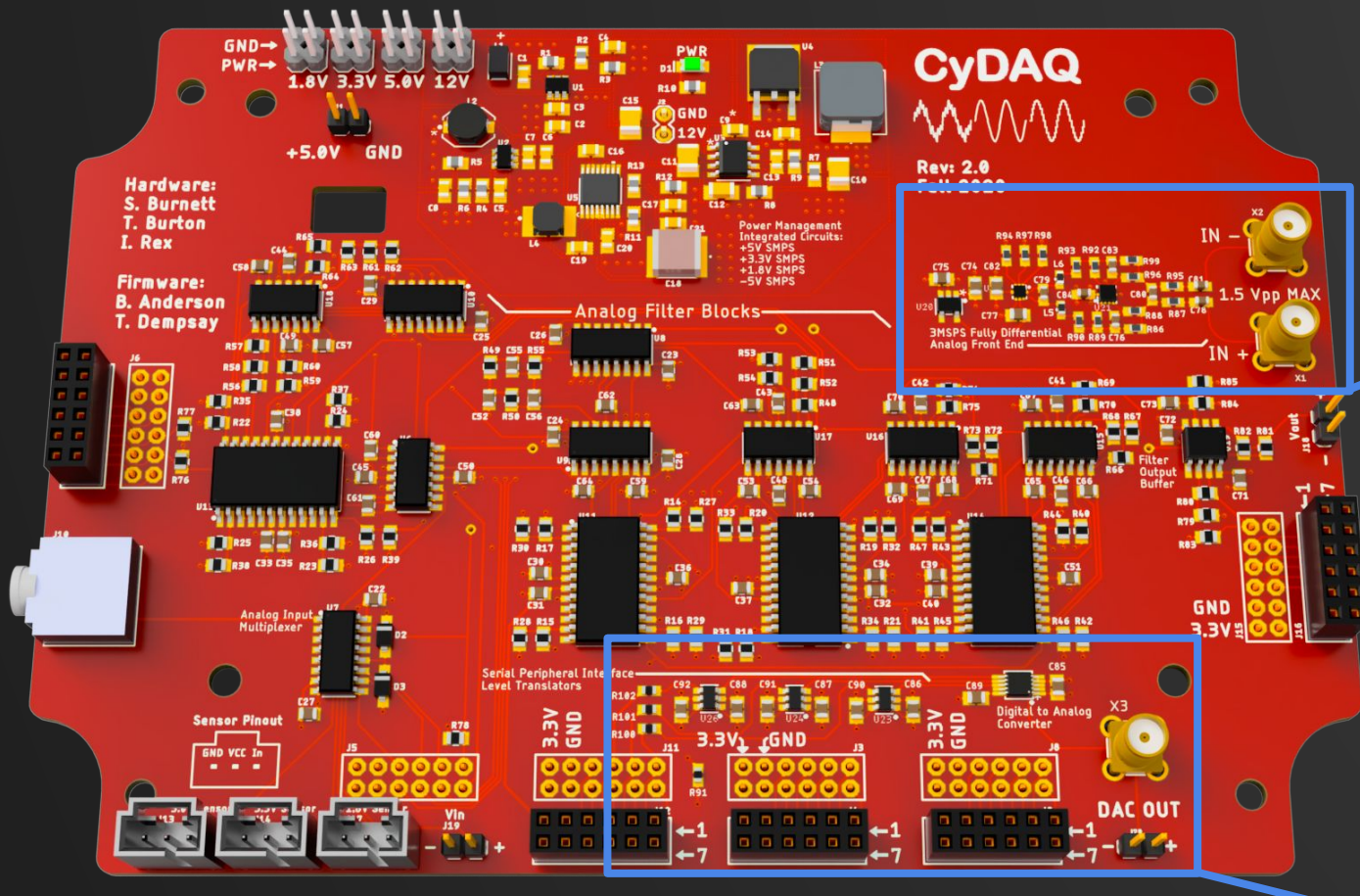
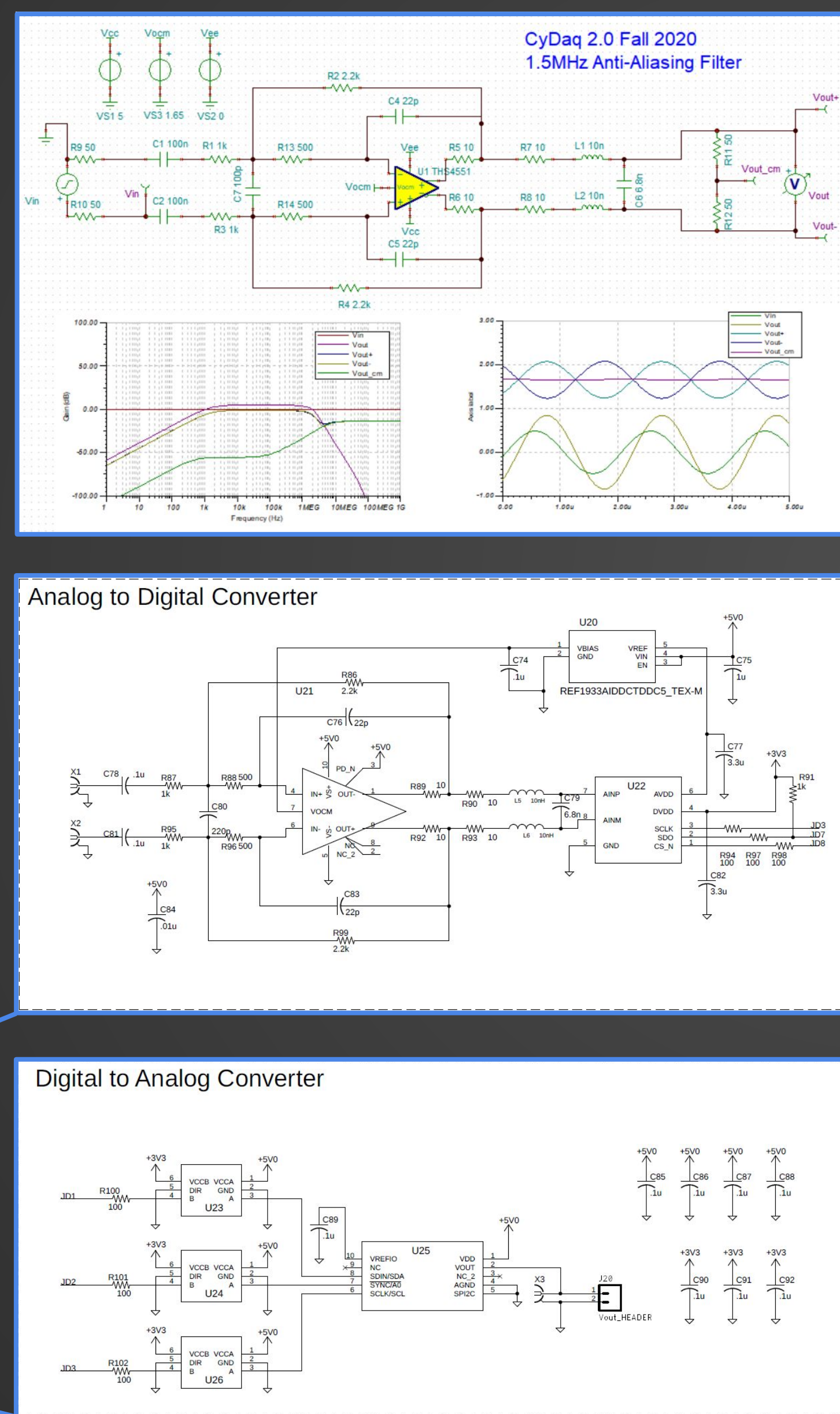
- Use the CyDAQ to redesign signal processing laboratory curriculum
- Incorporate real-world applications and hardware into the Signals & Systems curriculum
- Design firmware, software, and hardware to support the CyDAQ system

General Overview:

- Teaching platform for EE Signals & Systems curriculum
- Uses hardware to reinforce textbook theory
- Labs designed to introduce industry design engineering concepts

Hardware

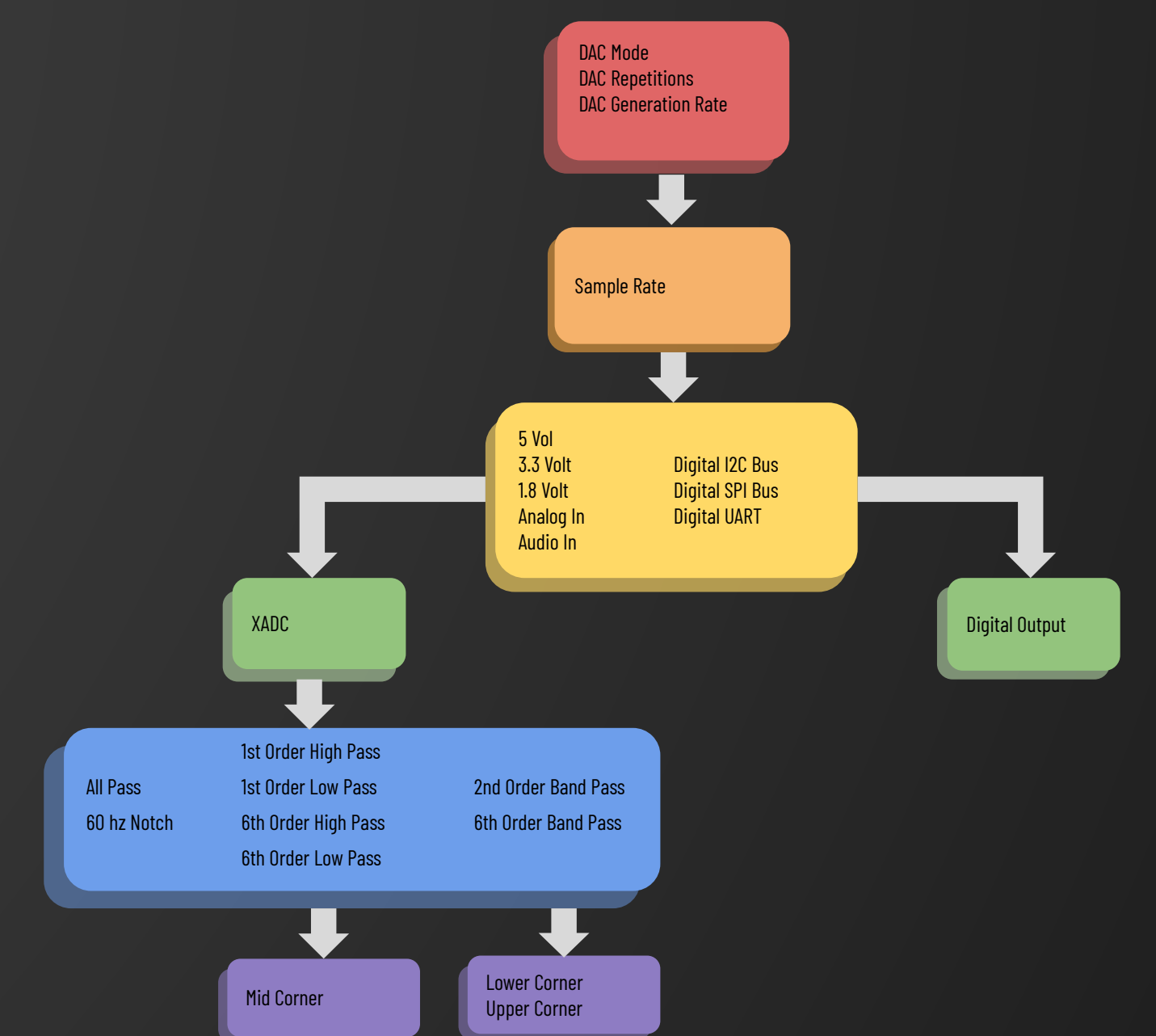
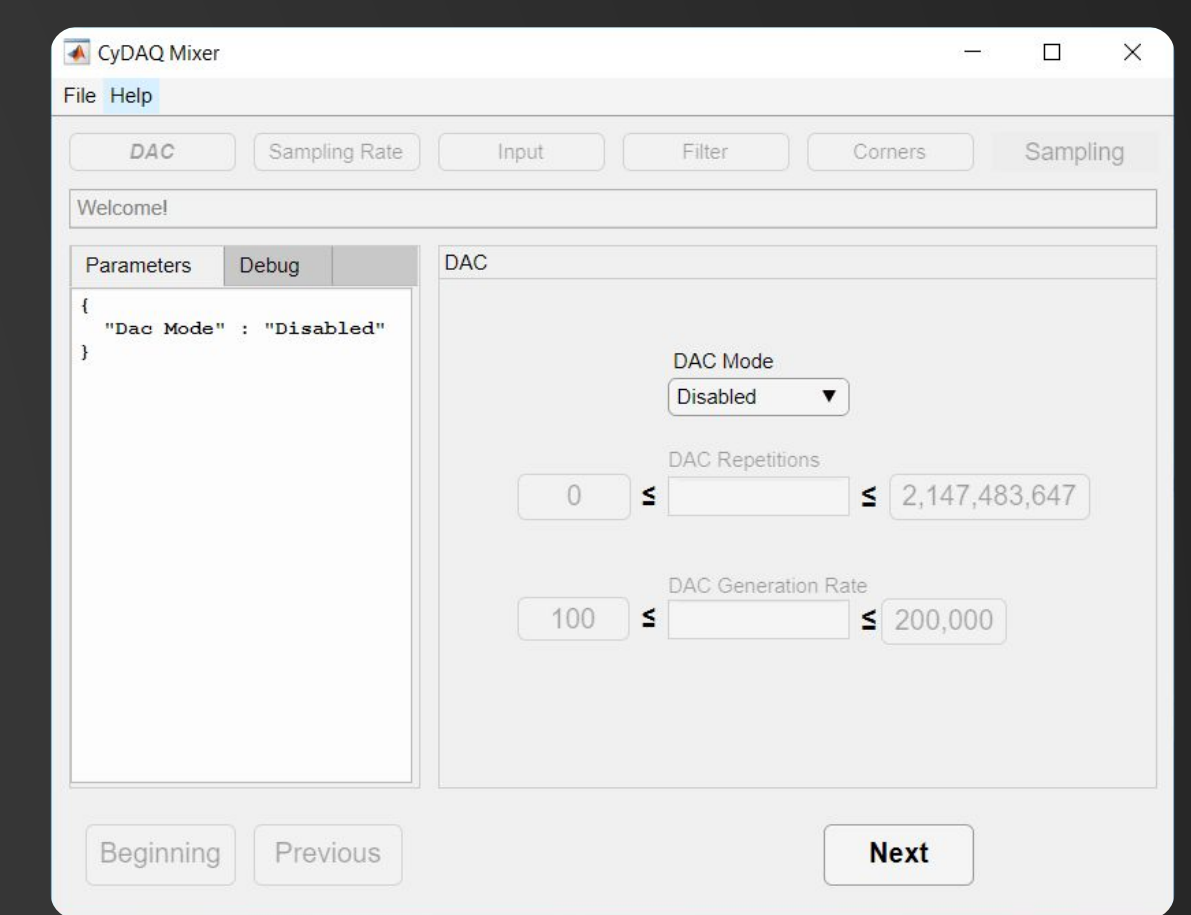
- Analog input: 3MSPS ADC with fully differential, active multiple feedback 1.5MHz anti-aliasing filter
- Analog output: SPI DAC with buffered 5Vpp single-ended output
- Peripheral Module to bring new hardware functionality to legacy CyDAQ Rev. 1 models
- Full layout revision for new circuits



Front End

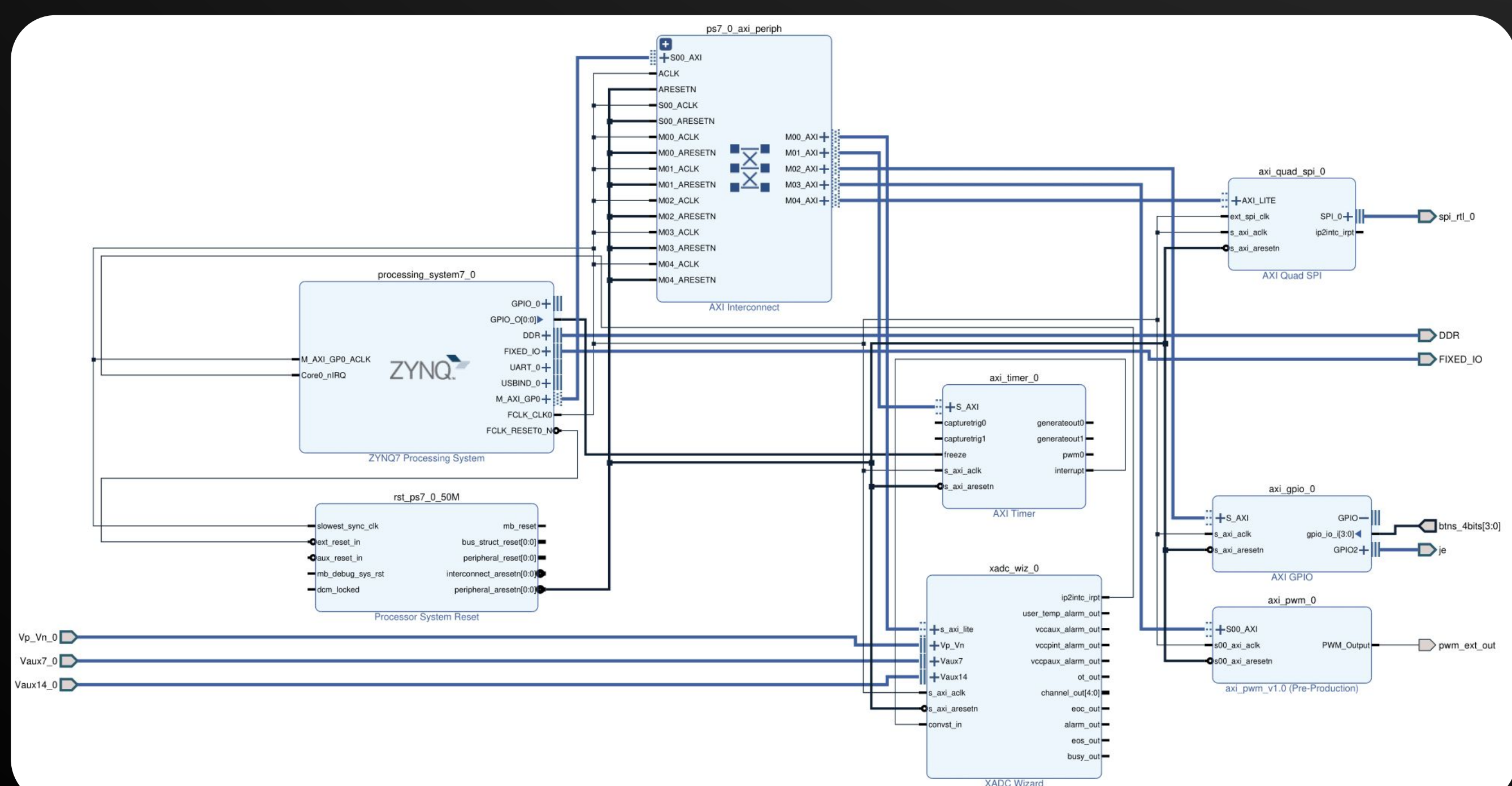
CyDAQ Mixer:

- Front-end in MATLAB, back-end in PYTHON
- Provides step-by-step direction on picking the right parameters for the CyDAQ to run on
- User proof: Mixer will not allow you to configure the CyDAQ with an invalid set of parameters
- Simple design for students using it for the first time



Firmware

- 50MHz SPI Controller in fabric
- Custom PWM core in fabric
- External SPI ADC and DAC drivers
- Arbitrary waveform generation via dataset upload
- High-speed interrupt-based firmware



Labs

- Created, tested, and wrote answer keys for 8 Signals and Systems labs
- Lab Examples:

EE224:

- Noise filtering in hardware(EE 224)
- DSP image restoration (EE 224)
- Heart rate monitor design (EE 224)

EE324:

- System dynamic modeling (EE 324)
- Loop response measurement (EE 324)
- Ball & beam controller design (EE 324)

