

Water Capture Device Signal Integration Circuit Board

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I. Introduction

I am a junior in electrical engineering at Arizona State University, and this is my second internship at Johnson Space Center. I am an intern in the Command and Data Handling Branch of Avionics Division (EV2), my previous internship was also in EV2.

During my previous internship I was assigned to the Water Capture Device payload, where I designed a prototype circuit board for the electronics system of the payload. For this internship, I have come back to the Water Capture Device project to further the work on the electronics design I completed previously.

Water Capture Device is an experimental payload to test the functionality of two different phase separators aboard the International Space Station (ISS). A phase separator sits down stream of a condensing heat exchanger (CHX) and separates the water from the air particles for environmental control on the ISS. With changing CHX technology, new phase separators are required. The goal of the project is to develop a test bed for the two phase separators to determine the best solution.

II. Objective

The Water Capture Device payload incorporates different sensors and pumps in the system. To control these components, the components need to be powered and the sensor signals need to be incorporated and transferred to a microcontroller.

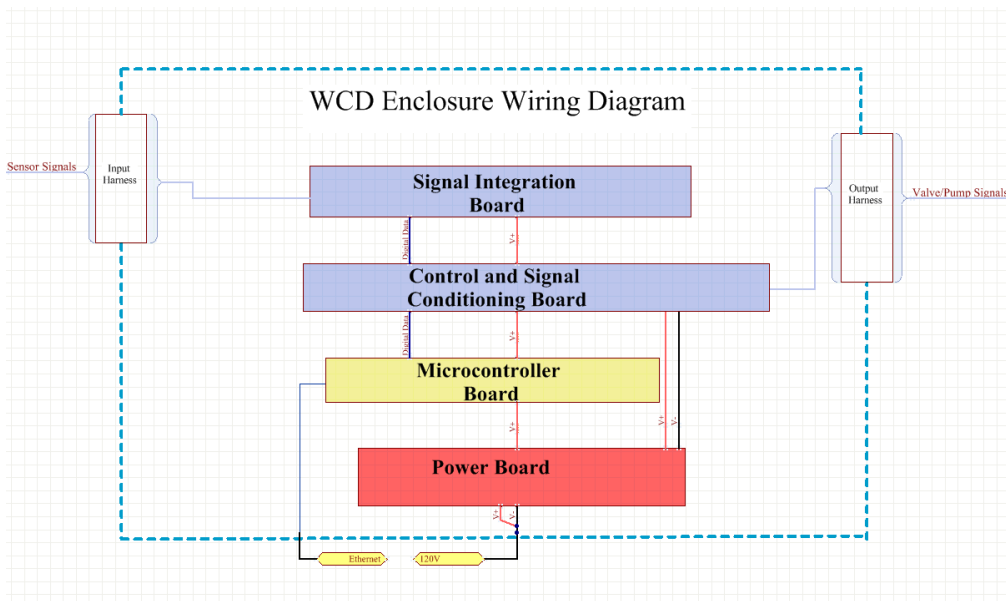


Figure 1: Water Capture Device electronics enclosure. Details how the component signals will be powered and processed for operation of the system.

Figure 1 shows the four circuit boards needed to operate and control the system. My goal was to design the "Signal Integration Board", a circuit board that integrated the sensor signals and conditioned the signals to safe, readable signals for the

microcontroller board. To relay the signal data to the microcontroller, my board needed to conform to the Modular Integrated Stackable Layers (MISL) form design. This means my board is be part of a larger stack of circuit boards used to control the payload.

III. Approach and Results

To design the circuit boards, this project relied heavily on design heritage from a similar project. This means that the circuit designs made previously are the foundation for my design; I used similar components and design ideas for the schematics I worked on. This worked to the teams advantage because the previous project has already been reviewed and tested, making it easier to expedite the design process for this payload. However, since the system components are not exact, and Water Capture Device does not have the same requirements, there were changes and additions to my schematics.

To begin designing the circuit board, I first determined the types of signals from the sensors. By determining the type of signal, I was able to determine the best way to condition them for the microprocessor. I determined there to be four different groupings of signals. Two of the groupings I was able to rely heavily on design heritage from the project previously mentioned, the other two groupings I had to design the conditioning for myself. I used Altium Designer as the program to design my schematics, and used schematic hierarchy to connect the schematic sheets as one major design.

Once my schematics were completed, I had an initial design review with my mentor. I made changes based on his recommendations, and then I hosted a design review with engineers within the EV2 branch. Significant changes were made based on this design review.

Once the schematics are finalized, I will begin work on a printed circuit board (PCB) layout. This is an important part of the design process to ensure the quality and health of the signals on the board. After the PCB is deigned, the circuit board can be fabricated and will be ready for testing and analysis.

IV. Conclusion

By the end of my tour I had completed a design for a circuit board with seven schematic sheets. This experience allowed me to apply technical lessons I have learned in school as well as apply what I learned during my previous internship. During my experience this semester I learned technical lessons about grounding, safety requirements, signal integrity, and improved my skills with the program Altium Designer. I also gained skills in project management and technical communication; working with a large team of different engineering disciplines meant I had to adhere to scheduling guidelines and communicate how to integrate my work with other team members' work.

This experience of working with a large team will help me better communicate on future projects, and help me understand how engineers come together to complete a payload. And the technical lesson I gained from designing a large circuit board will prepare me for future design projects in my classes at college.

V. Acknowledgments

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