

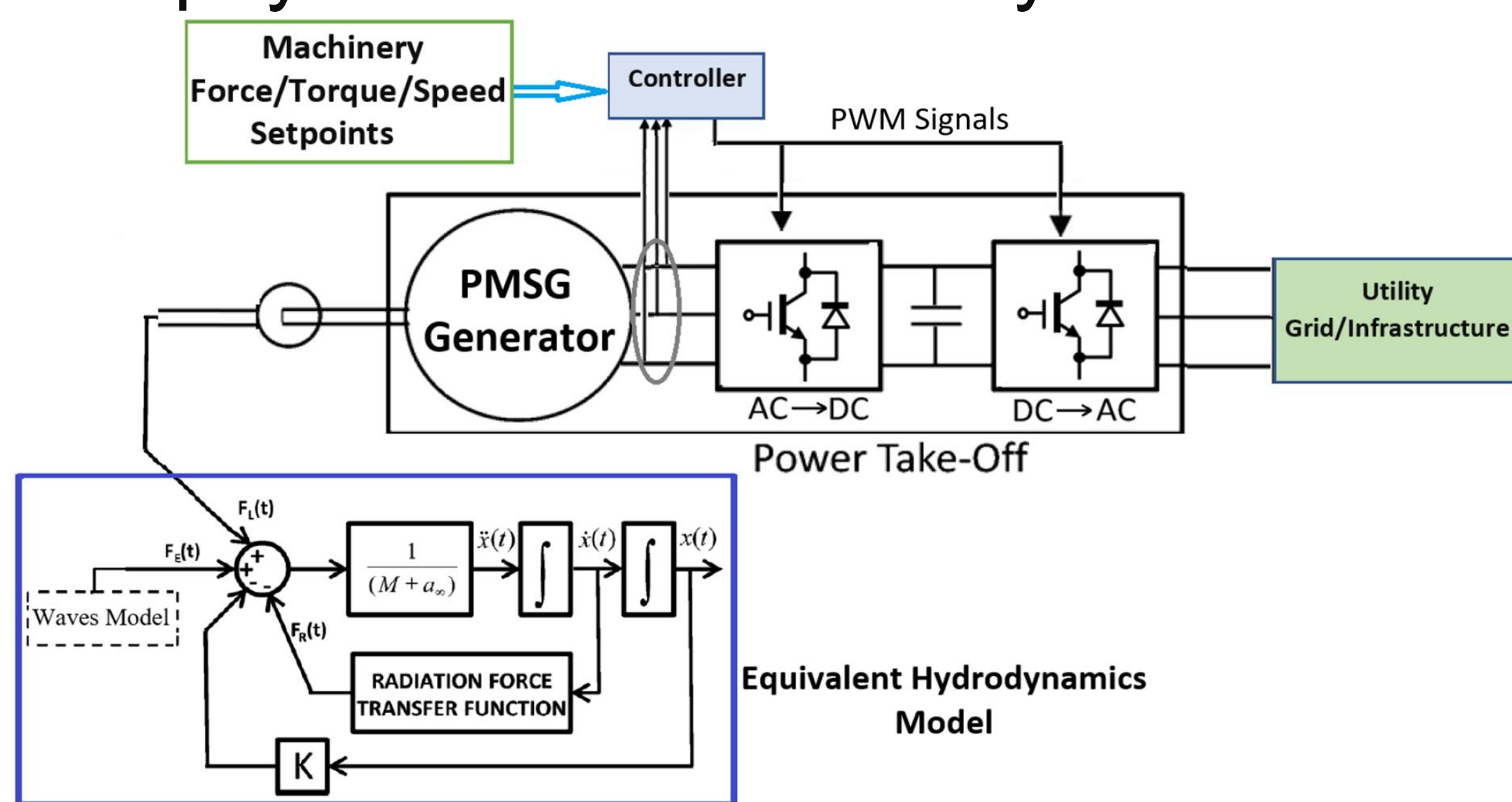
Design and Hardware Development of a Modular Multi-Level Inverter for Wave Energy Converter Power Take-Off System

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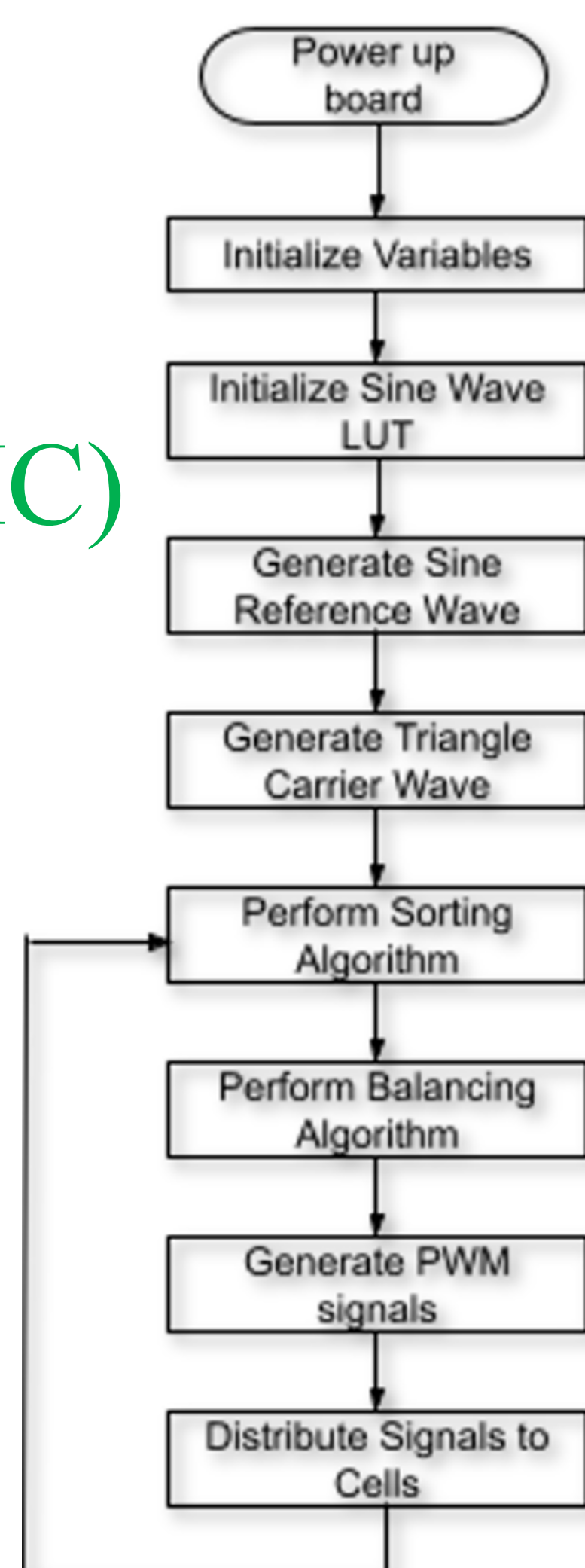
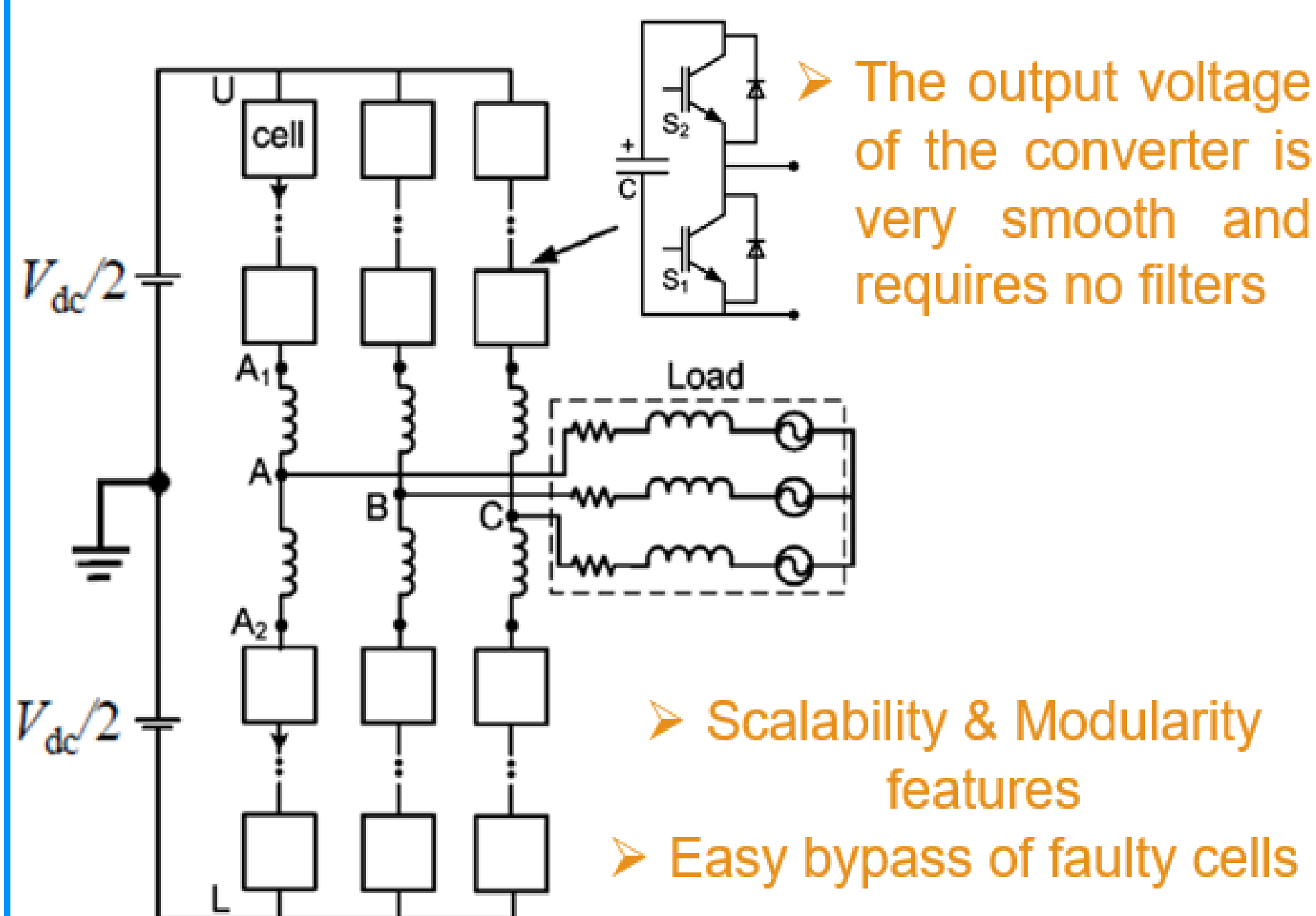
Faculty Advisor: Dr. Hamed Nademi, Electrical Engineering Department

Background and Motivations

- The goal of this project is to develop Power Take-off system to integrate marine renewable energy resources.
- An estimated numbers for Carlsbad Desalination Plant are: \$5 cost per 1000 gallons produced clean drinking water, thus for this plant with capacity of 50 million gallons per day, the daily expenditure of \$50,000 electricity bill is expected.
- An annual expenditure of \$18.25 million is calculated for this plant to pay to the SDG&E utility.

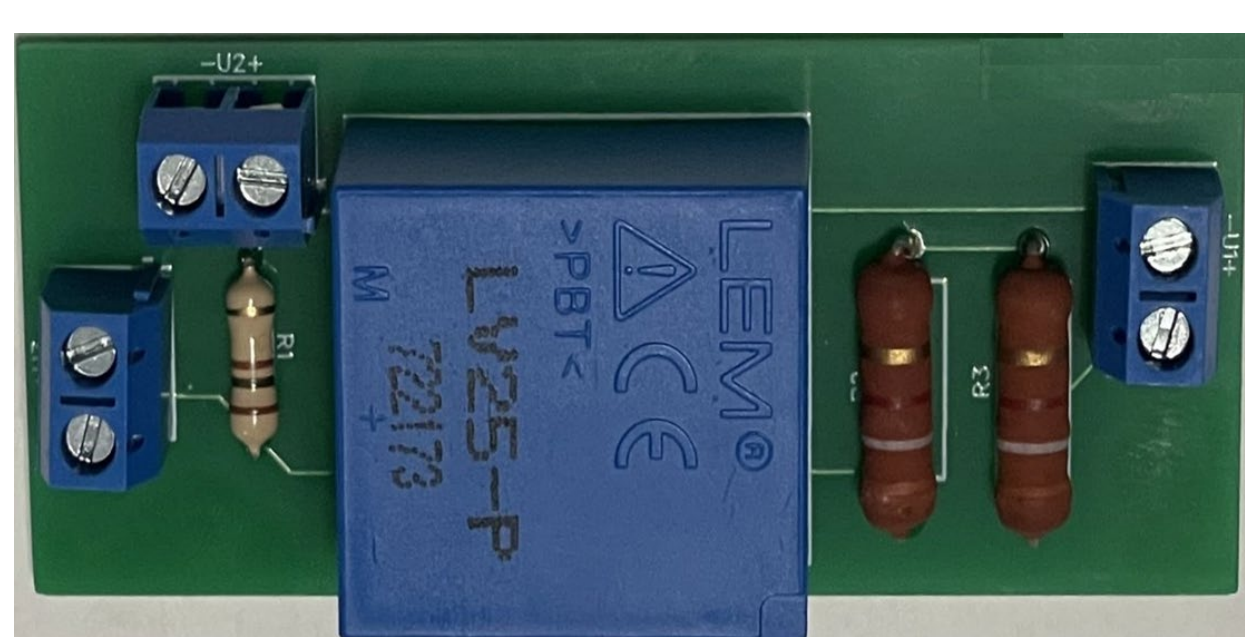


Modular Multilevel Converter (MMC)



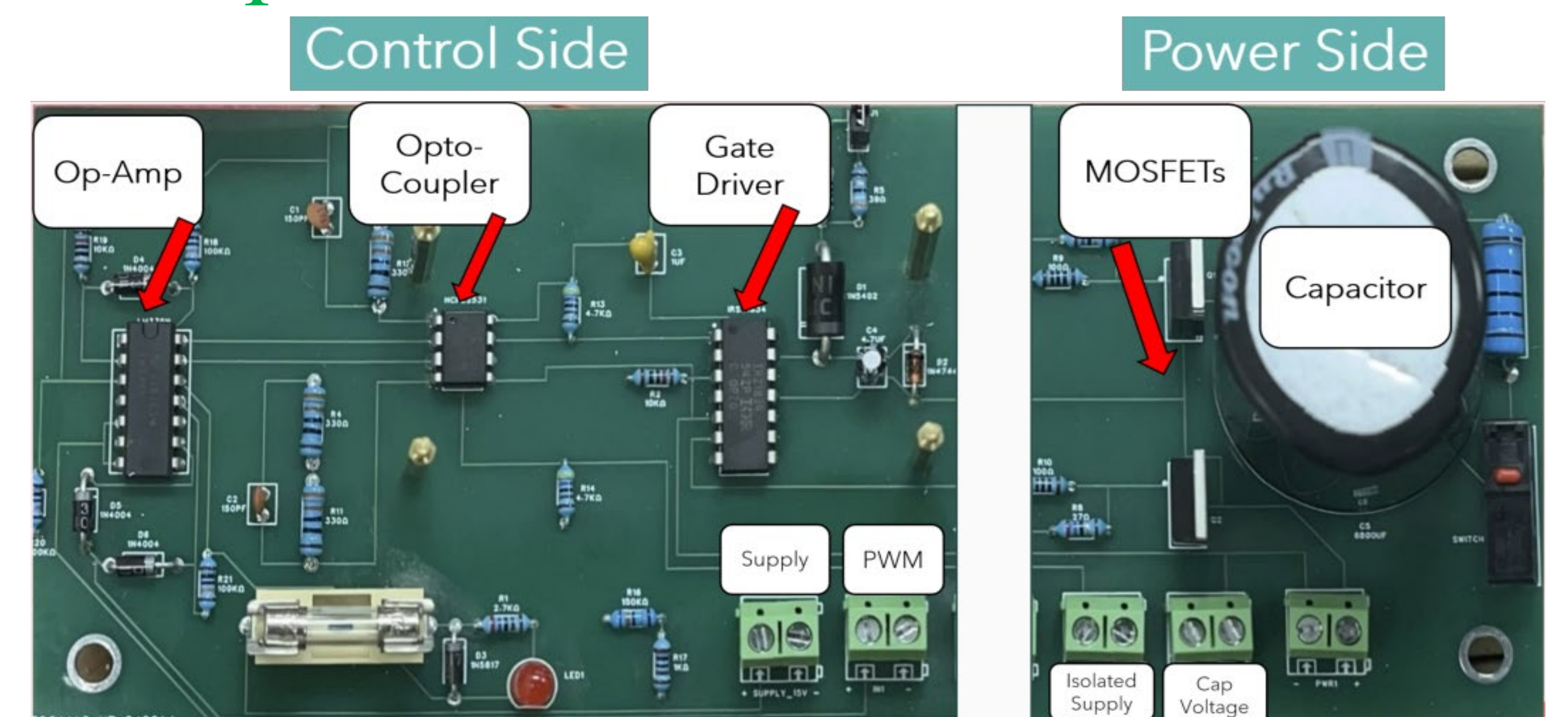
- MMC prototype built based on half-bridge cell topology, 6 cells per phase with 6 voltage sensors and two current sensors. Utilizing an FPGA board to generate PWM control signals for 6 separate cells.

Voltage and Current Sensors PCB Boards

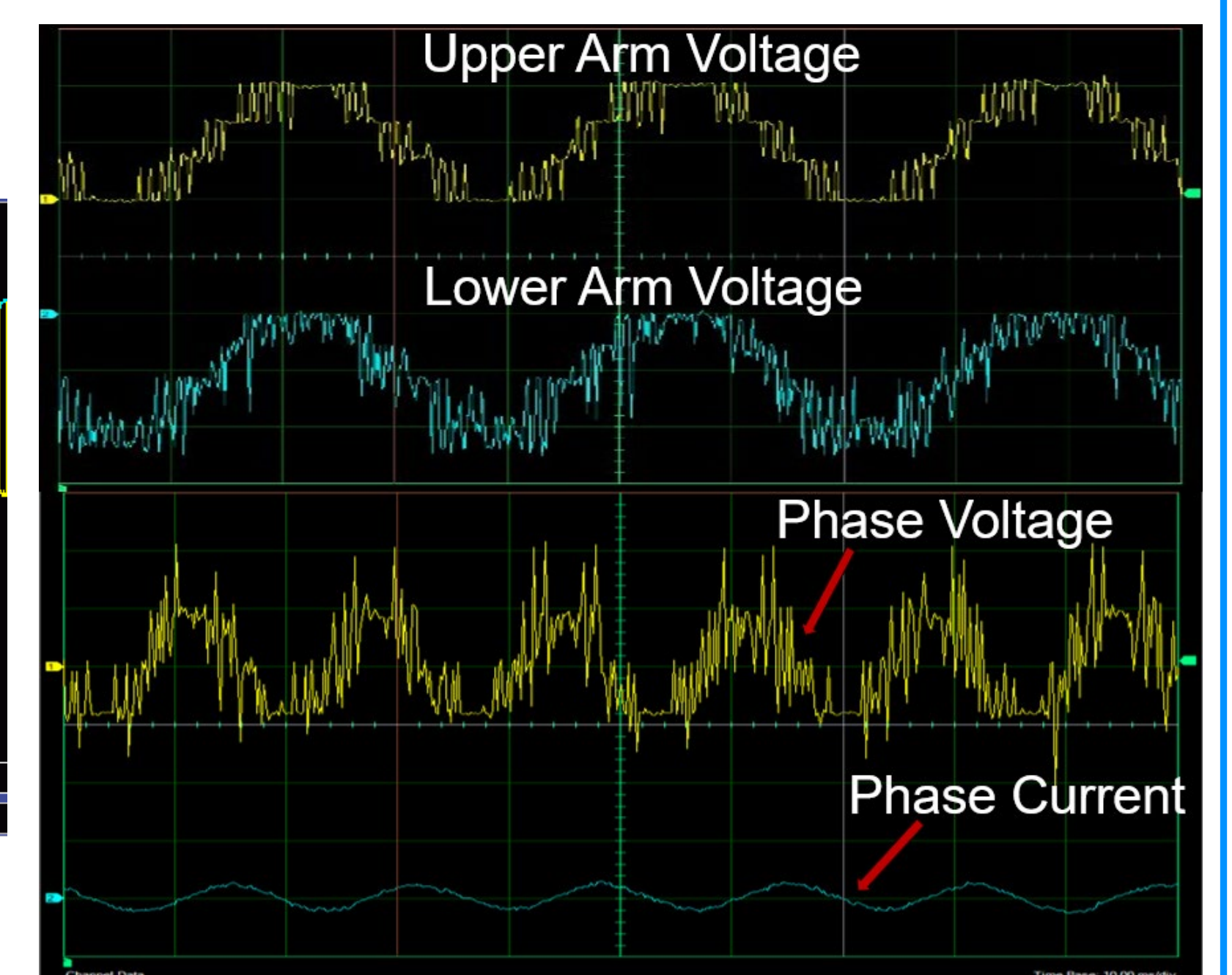
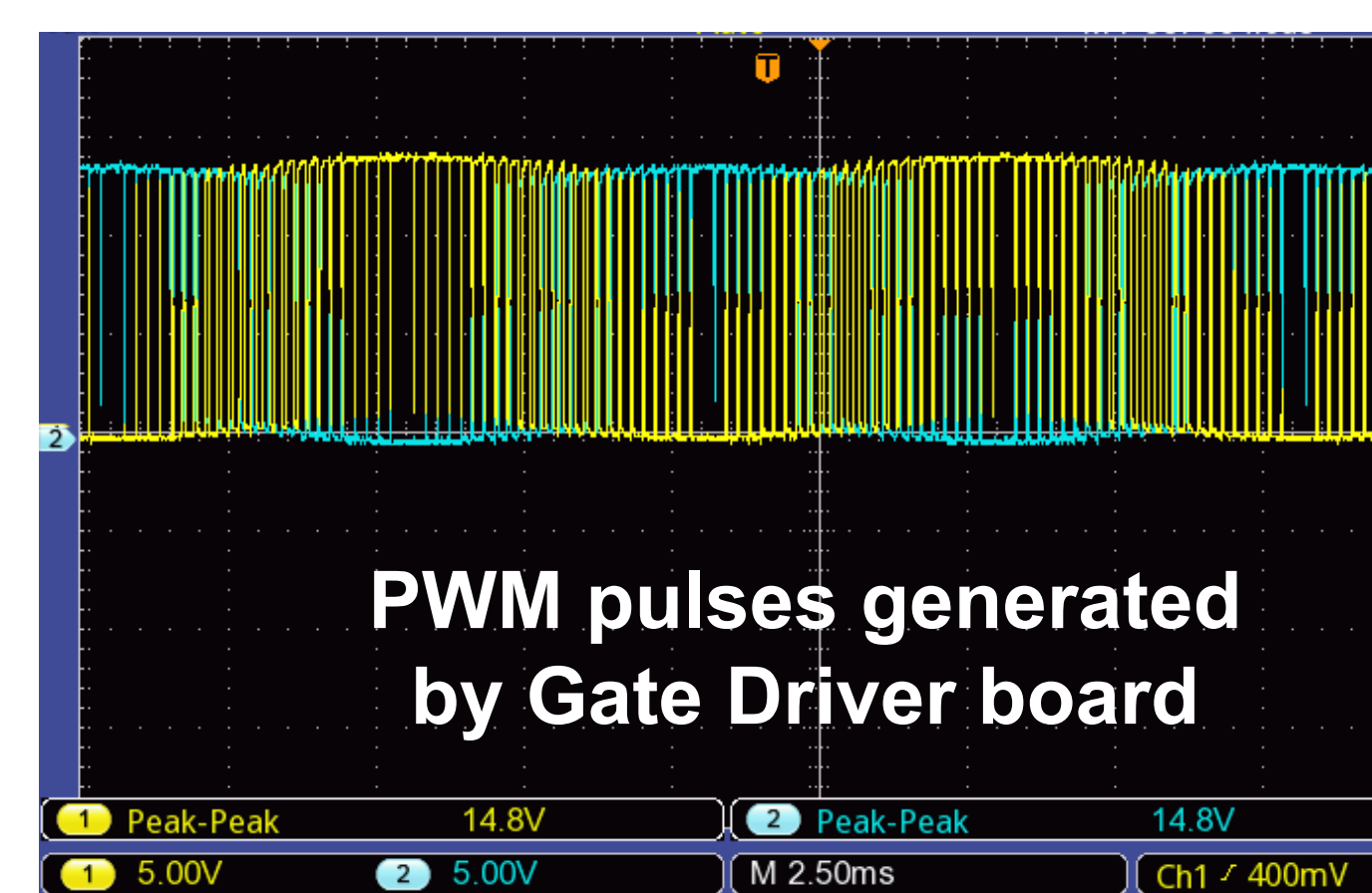


- Voltage & Current Sensors designed for implementation of the capacitor voltage balancing algorithm and controls.
- Output of one cell is cascaded to the input of the next cell. The control circuit regulates the signals are fed to the MOSFETs via gate driver resistances.

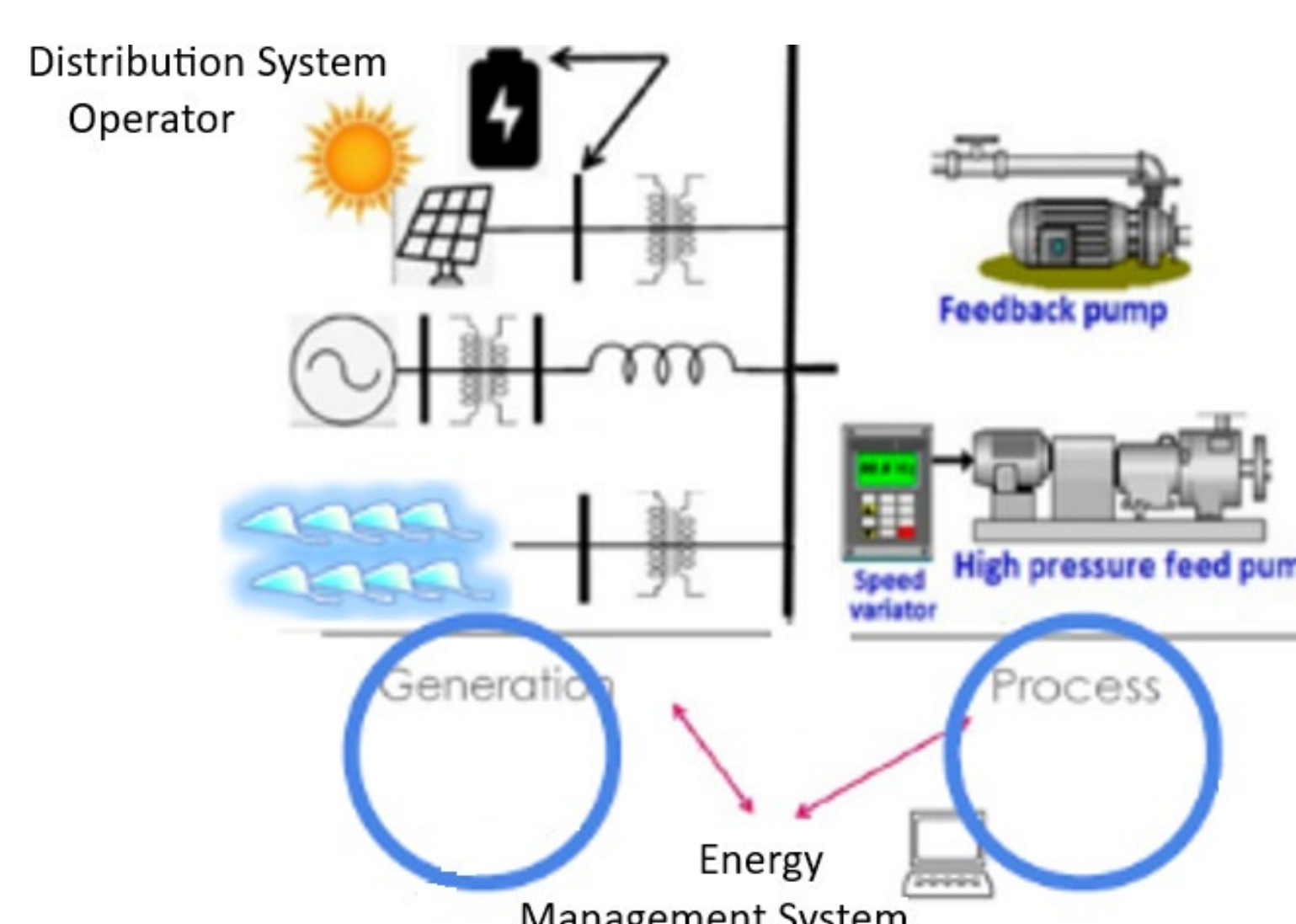
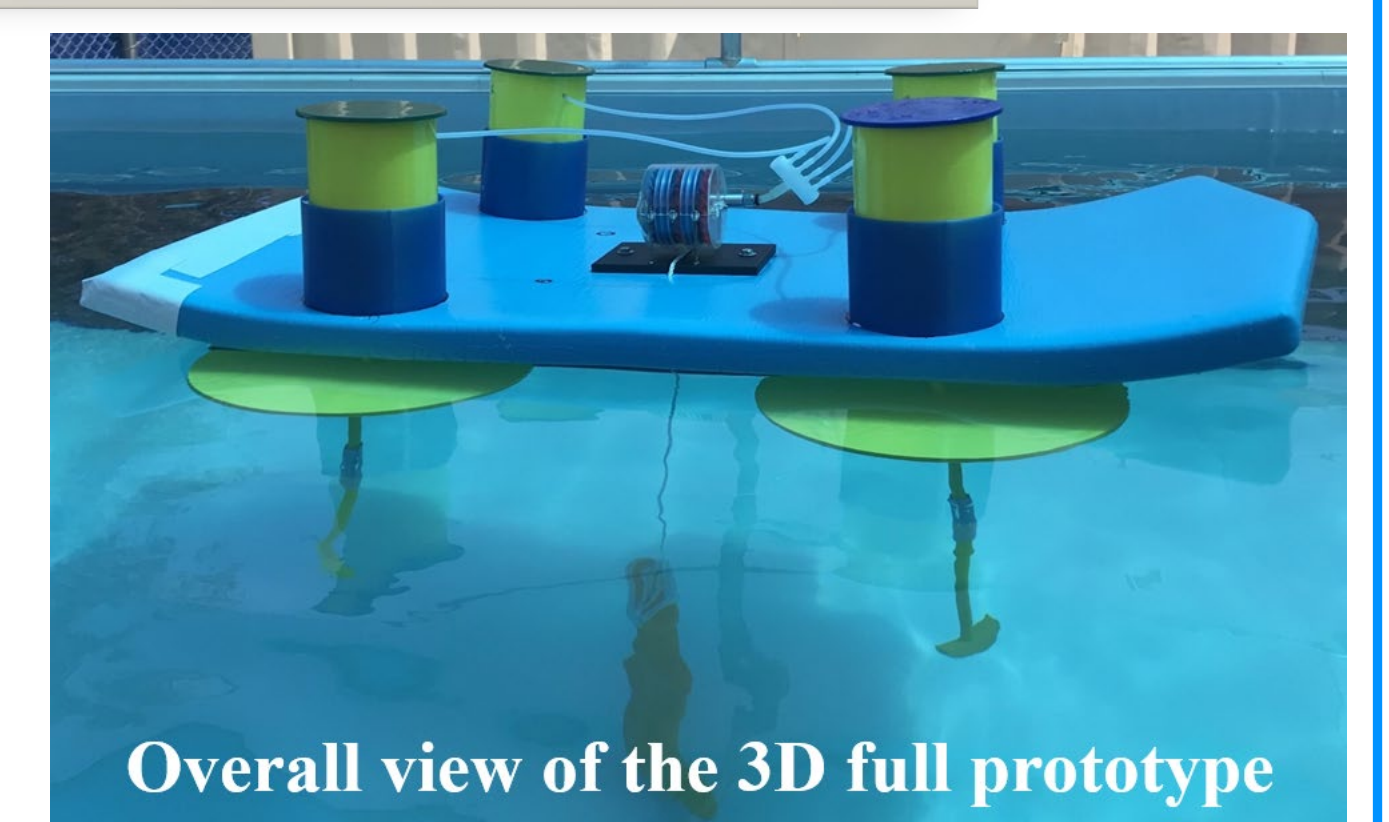
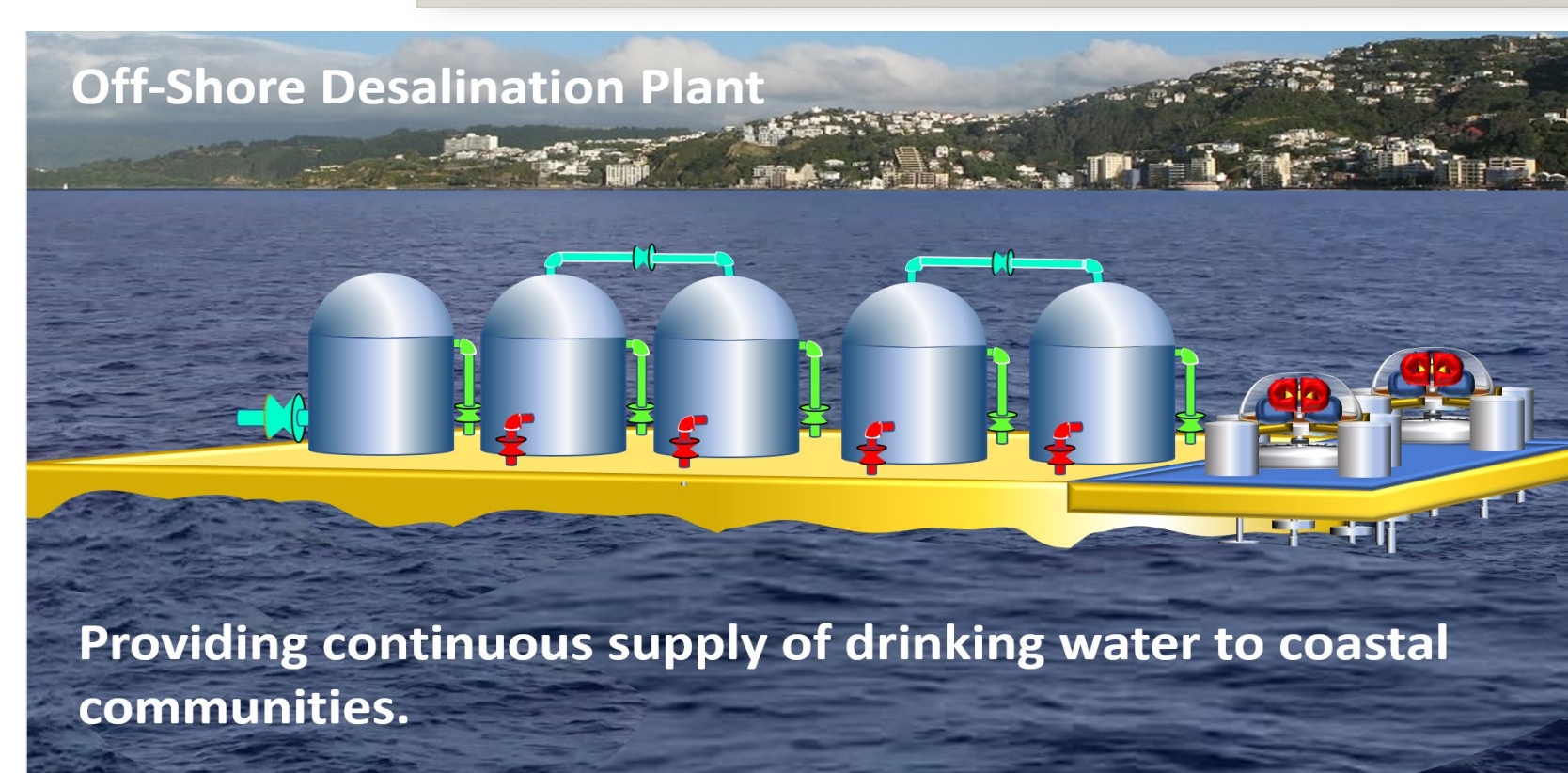
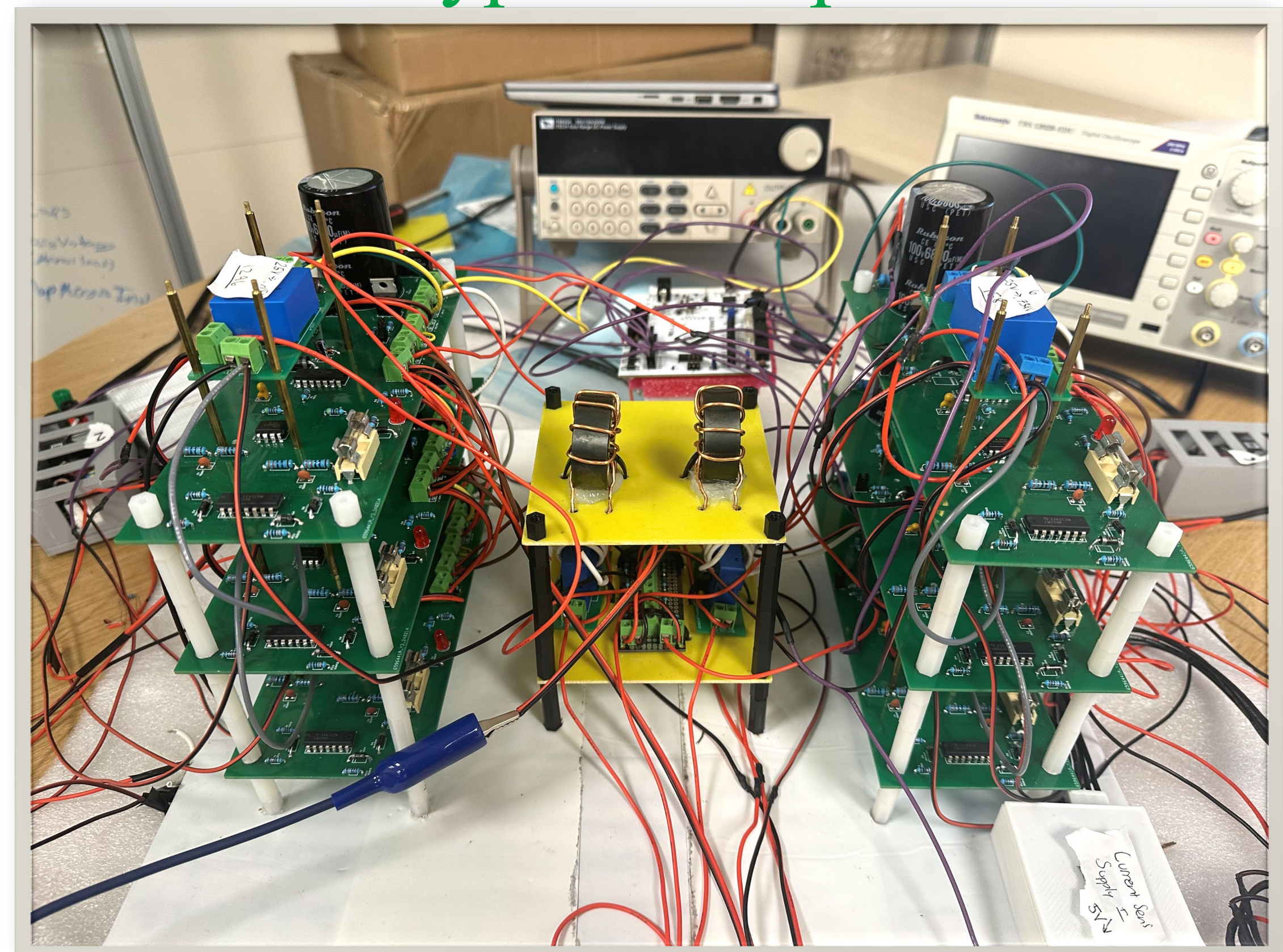
Complete Cell Fabricated on the PCB



- The experimental waveforms show the output AC phase voltage & current of the MMC Inverter supplying an AC motor load satisfying the IEEE-Standard 519, Harmonic Distortion levels.



Built MMC Prototype for Experimental Testing



Exploring a Marine Renewables Interfaced with a Freshwater Production Plant will be the focus of our future work.