

# An Experimental Setup for Lifetime Testing of Lithium Ion Batteries in Marine Conditions

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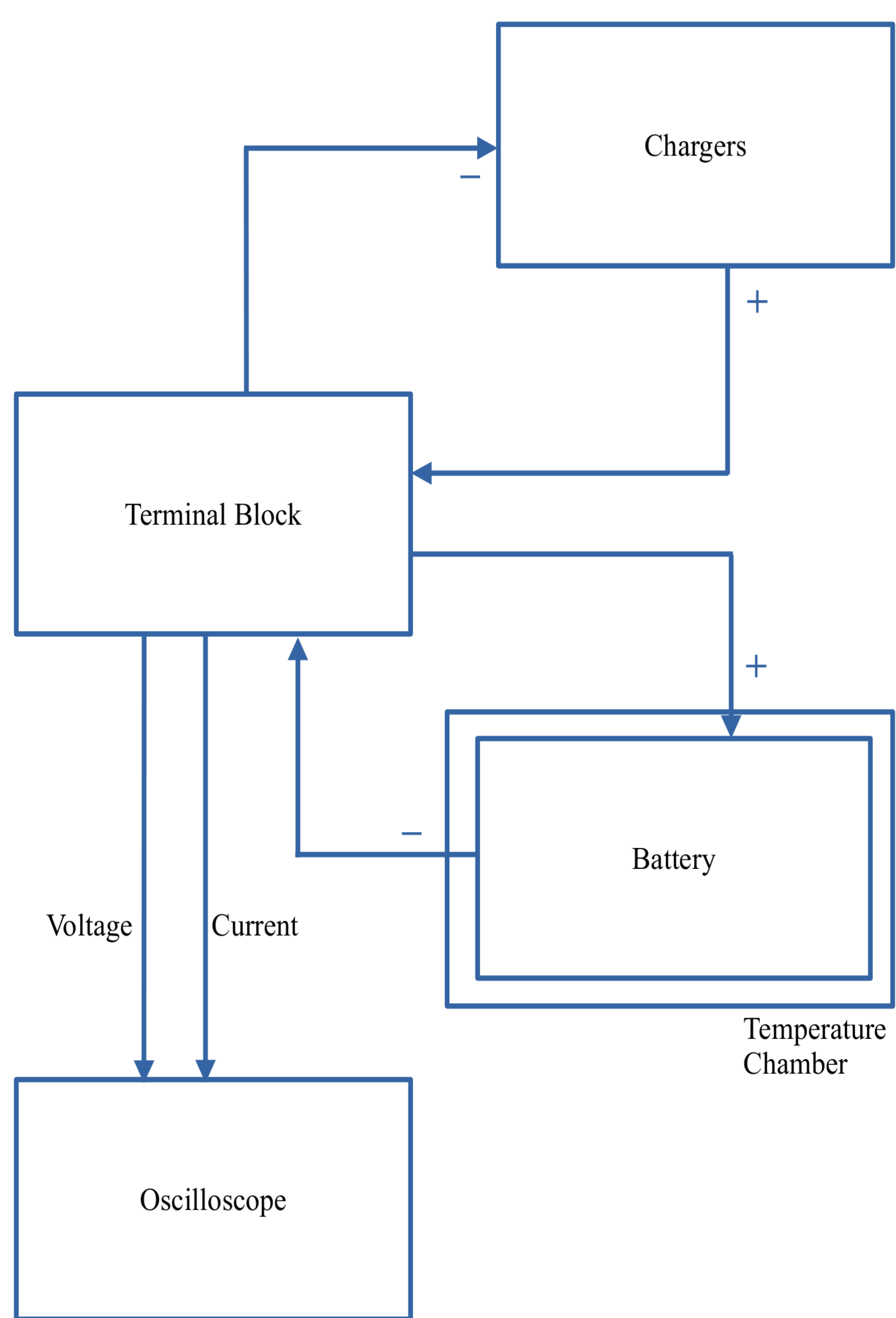
An environmentally controlled setup for testing the effect of marine temperature and weather conditions on battery lifetime and degradation, including major system components, communications, and data acquisition, as well as intended future testing.

## TESTING PLAN

Repeated charge and discharge cycles of a Lithionics lithium battery in several temperature conditions to measure and model the rate of battery degradation as a function of environment. A temperature chamber is used to control the ambient temperature to three marine environment seasons:

- Winter: 5 degrees C
  - Summer: 25 degrees C
  - Hot summer: 35 degrees C
- The rate of battery degradation, measured as rate of capacity decrease and rate of internal resistance increase, will be measured in each condition.

## SETUP



The Lithionics GTX12V320A-E2107-CS200 LiFePO<sub>4</sub> battery within the temperature chamber.

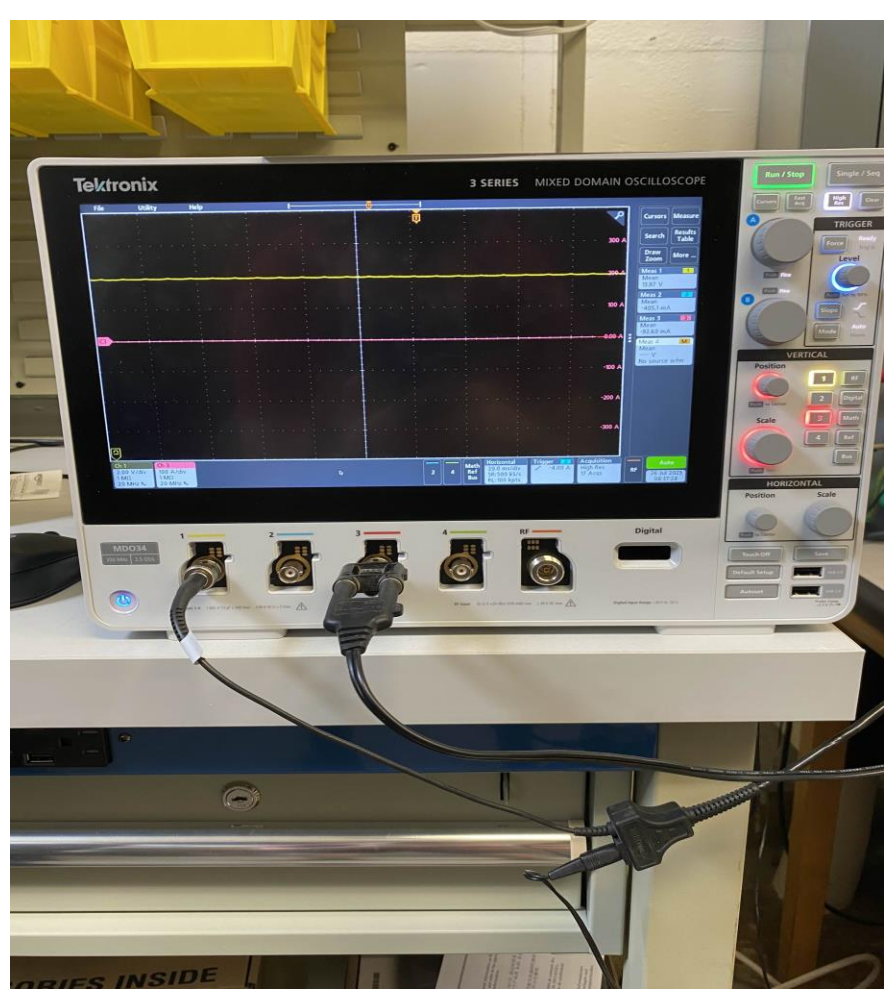


The Elektro-Automatik 10920-125 DC power supplies connected in parallel.

## CHARGERS

The chargers are Elektro-Automatik 10920-125 DC power supplies. Each individual supply is capable of delivering up to 920 V and 125 A for a total power output of around 18 kW.


Two of these supplies are connected in parallel to provide a maximum bi-directional current output of 250 A. The maximum charge and discharge current for this experiment is 200 A.



The Tektronix MD034 oscilloscope. Channel 1 is connected to the voltage probe, Channel 3 is connected to the current probe.




The Binder KMF 720-240V constant climate chamber. Currently set to maintain room temperature (77 °F).




### BATTERY

The battery is a Lithionics GTX12V320A-E2107-CS200 lithium-iron-phosphate (LiFePO<sub>4</sub>) battery. It has a nominal capacity of 320 Ah and a maximum charge/discharge current of 200 A. The battery comes with an internal BMS system that monitors parameters such as SOC and battery and BMS temperature.



### OSCILLOSCOPE

The oscilloscope is a Tektronix MD034 oscilloscope with a bandwidth of 350 MHz and a maximum sampling rate of 2.5Gs/second. This particular model is being utilized due to it’s ability to capture waveforms over an extended period of time, as well as it’s ability to save waveforms in data formats suitable for processing.



### TEMPERATURE CHAMBER

The temperature chamber is a Binder KMF 720-240V constant climate chamber. It is capable of maintaining a constant temperature for ranges between 14 – 212 °F (-10 – 100 °C), which is more than acceptable for the intended testing range of 41, 77, and 95 °F (5, 25, 35 °C).