Power Scraping Module

An Energy Harvesting Device For Remote Sensor Networks

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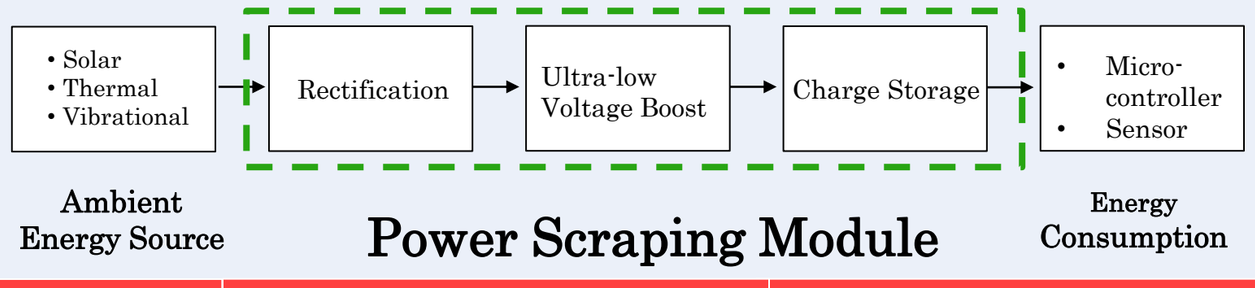
Problem Statements

- Research and develop a device that will efficiently collect, convert, and store low voltage energy.
- Take an extremely low AC voltage as a source and convert it to a usable DC voltage that can power various components in a system.

Solutions

- Provide an alternative self-powered source for devices.
- Create a device that is able to take intermittent, previously unusable ambient energy and multiply it.
- Energy stored can be used for many wireless applications such as powering remote sensors for data collection.

Conceptual Sketch



Requirements

Functional

- Converting 1.1V AC Peak to Peak Voltage to 3V DC.
- The input signal is the only power source for the device
- Include a charge indicator in the output of the device
- The entire device must be contained within a 6” by 6” space.

Non-Functional

- The system should be as efficient as possible.
  - Minimize loss
  - Determine for every hour of energy scrapping, how many minutes will we be able to drive a 20mA LED.
- Stretch goals
  - Produce output of 5V
  - Use harvesting device as input
- Scalability

Engineering Standards and Design Practices

Digital design and Circuit standards

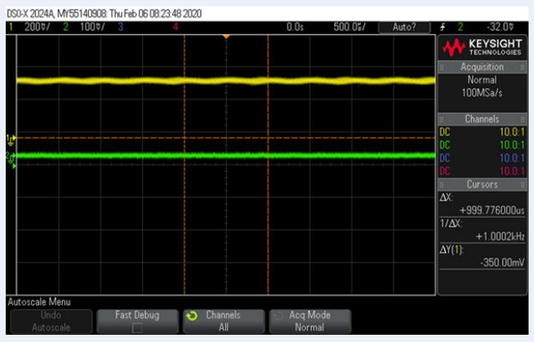
- Cadence simulated circuit testing.
- Readable circuit designs that follow design conventions.
- RoHS compliant circuit components
- Followed all electrical safety procedures.
- IEEE Code of Ethics

Budget

Total Cost of Prototype

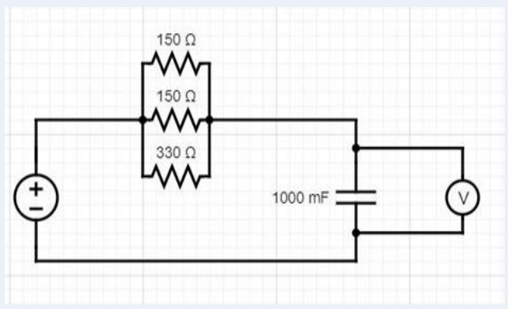
- 8x Schottky Diodes
- 1x EH 295 Booster Module
- 1x Supercapacitor
- 3 x LED
- Total Cost:$72.32

Rectifier Testing



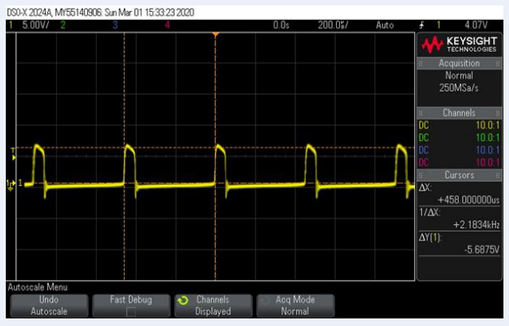
Full Wave Rectifier Testing with smoothing capacitor 10K ohms load 20uF smoothing cap

Capacitor Testing



Supercapacitor Testing Schematic

Booster Testing



Direct measurement of voltage booster with 0.5V input

Design Stages

1. **Rectification** – Full-wave rectifier to convert the AC input signal into a DC signal
2. **Voltage Boosting** - DC-AC booster module that increases an intermittent, low-voltage input to a higher voltage
3. **Energy Storage** - Stores the charge into a long-term storage component
4. **Charge Indicator** - Indicator that the energy storage device is being charged

Hardware & Parts Used

Rectification: Schottky Diode- SMC Diode Solutions

Voltage Boosting: EH4295 – Advanced Linear Device Inc.

Energy Storage: Supercapacitor – Illinois Capacitor

Charge Indicator: LED

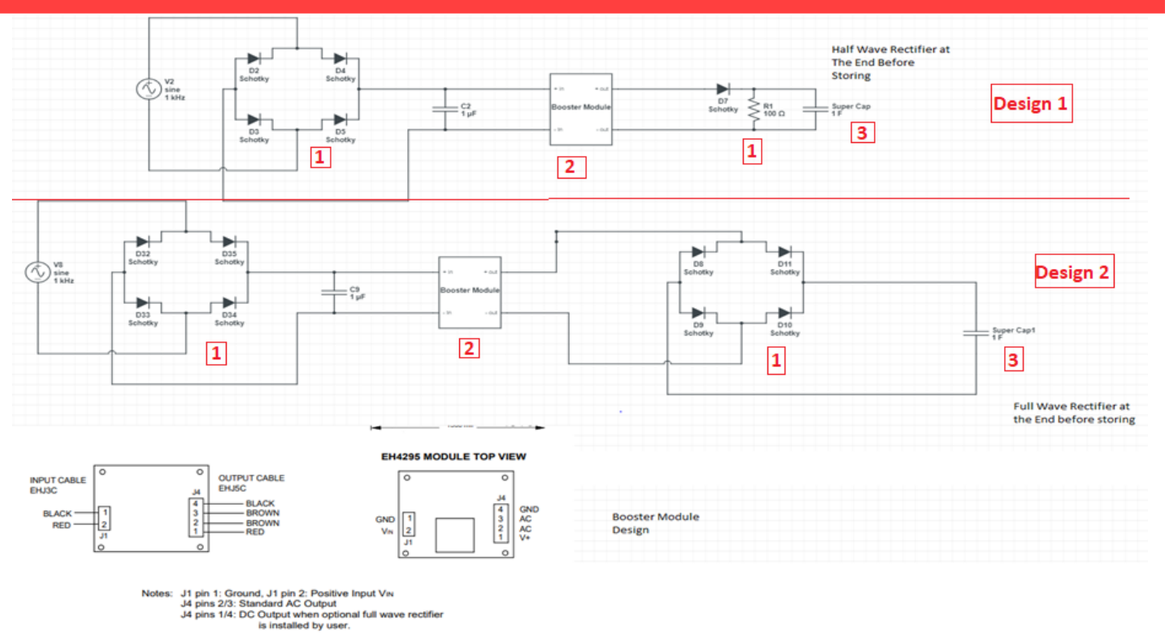
Tektronix 3021B function generator

Agilent DSO-X-2024A digital oscilloscope

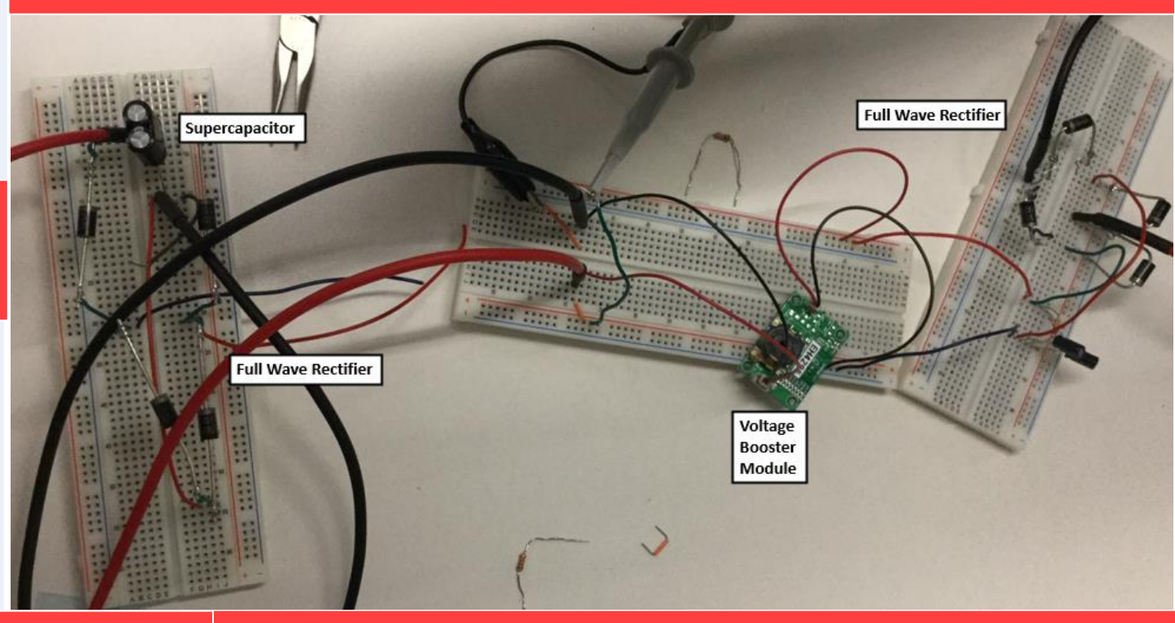
Intended users and uses

- Photovoltaic Power Station
- Power Plants
- Factories
- Wind Farm
- Implantable Devices
- Remote Patient Monitoring

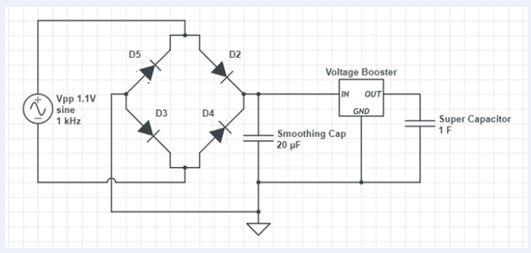
Design



Prototype Implementation



System Testing



Whole System Testing Schematic

Accomplished

- Designed self contained, energy harvesting unit given constraints listed above.
- Completed component level testing
- Investigated the inner workings of our booster module
- Explored alternative methods and parts

Future Work

- Complete system integration testing
- Detailed analysis of the performance of our system
- Find ways to improve the performance including: charge rate and lowest possible voltage input
- Strive for stretch goals
- Design and fabricate a PCB