Portable Solar Generator

EECE 404| Matthew Salazar | Spring 2026

Objective

This project involves the design and implementation of a portable solar generator. The system is composed of a 100W solar panel, a 12V, 10Ah lead acid battery, a 120V outlet receptacle, and two USB ports. The solar panel generates power to charge the battery, which is designed to supply up to 70W to the load.

Overview

- The goal of this project is to provide a practical solution to off grid power without the use of fossil fuel
- The Project is split into 3 subsystems: Battery Charger, USB Load, Outlet Load

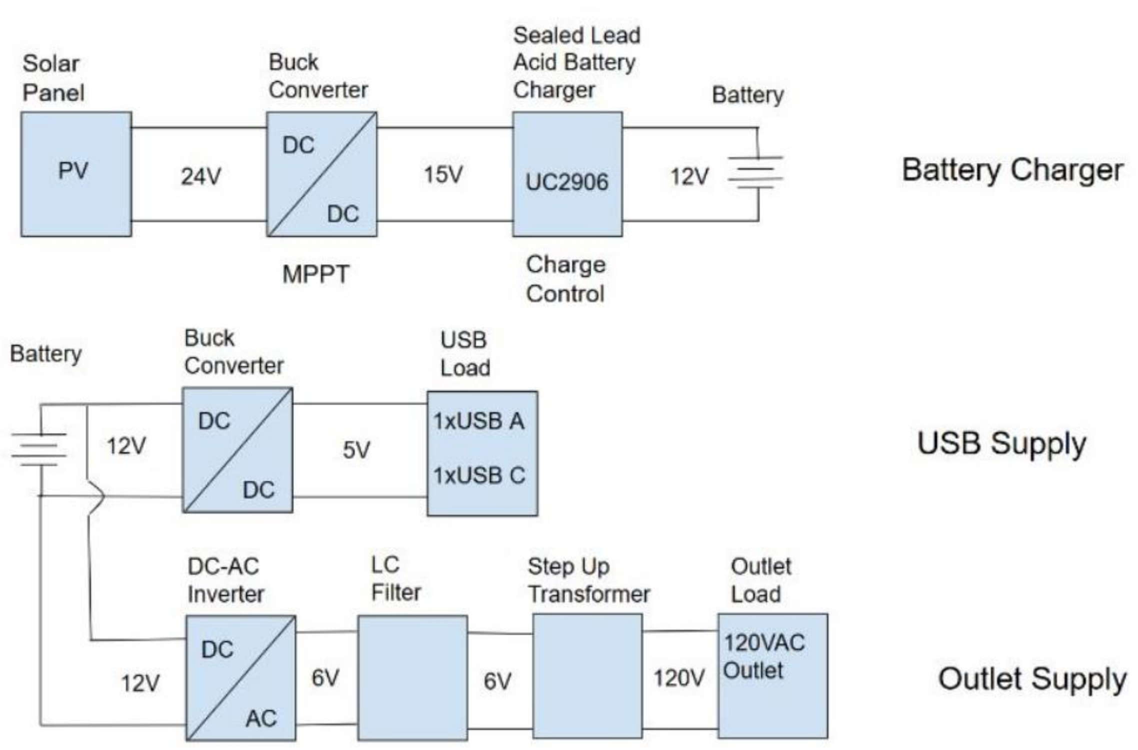

Figure 1. Portable Solar Generator Block Diagram

- The battery charger subsystem takes power from the solar panel and charges the battery with it
- The USB supply branch takes the power from the battery and supplies to USB ports with usable power
- The outlet supply branch inverts the battery voltage and boosts the voltage up to allow for a connection to an outlet receptacle

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Approach

Subsystem 1: Battery Charger

- A synchronous switching buck converter was chosen for better efficiency and a more stable output which is best suited to charge a battery
- A Teensy 4.1 microcontroller is used to implement output control for the synchronous buck converter
- The output voltage of the buck converter is kept above 17V, when possible, to properly feed the UC2906
- The UC2906 Sealed Lead Acid Battery Charging IC receives stable power from the buck converter and handles the battery charging control internally
- There is no direct solar panel control, the panel will only output as much current as the UC2906 pulls
- If the panel is capable of outputting more power when the current is already battery charger's limit, the voltage will increase to compensate

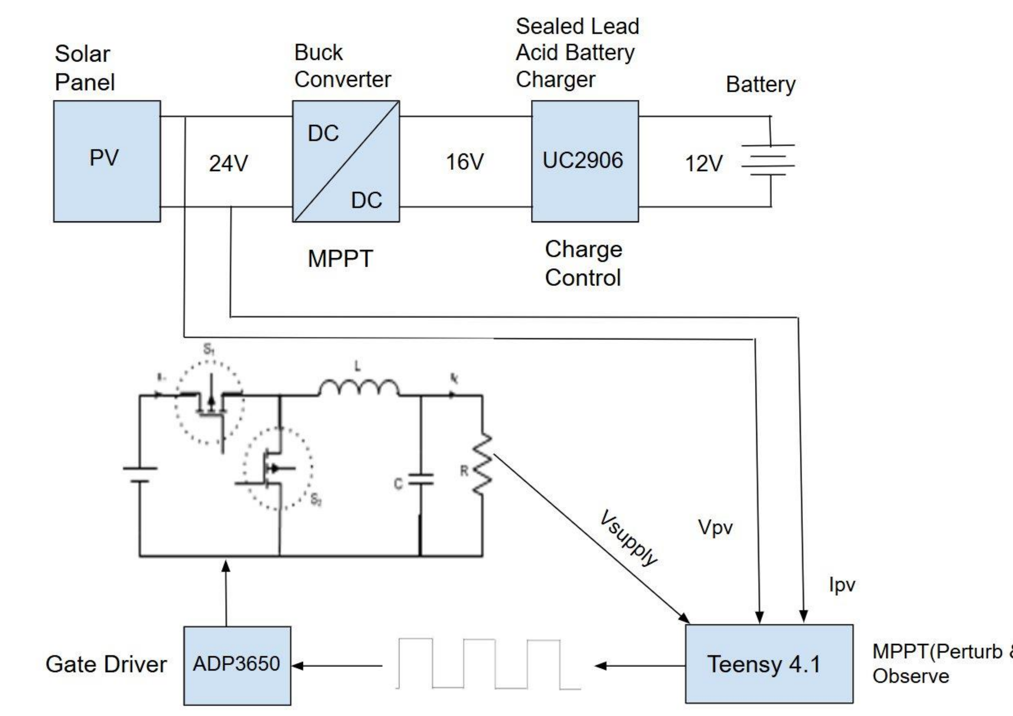

Figure 2. MPPT Buck Converter

Subsystem 2: USB Load

- Low Side switching was chosen for its simple gate drive circuit
- The two USB loads are USB Type A and USB Type C rated for 10W total
- The Type A can draw up to 0.5A while the Type C load can draw up to 1.5A at 5V
- The microcontroller maintains 5V at the output by constantly sampling the voltage at the high side and low side of the output and keeping the difference at between 5V-5.5V

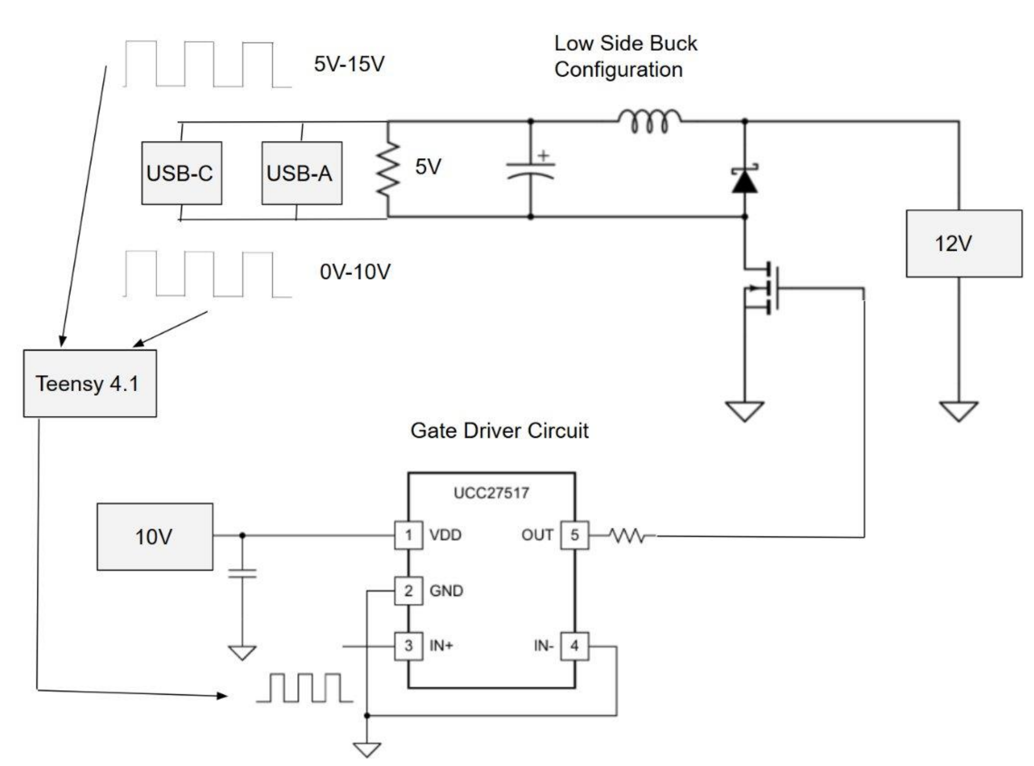

Figure 3. USB Buck Converter

Subsystem 3: Outlet Load

- Full Bridge Inverter was chosen because it inverts DC to AC without dropping voltage
- The Inverter takes PWM from a microcontroller to send a 60Hz sine wave carrier signal at a high switching frequency allowing for smaller components
- An LC filter is placed at the output of the inverter to act as a low pass filter allowing only the 60Hz sine wave to be recovered
- From there, a Step-Up Transformer takes the sine wave and steps the voltage up from 12VAC to 120VAC
- The Outlet Load is a basic outlet receptable rated for 120VAC and 15A
- While the outlet receptable can handle much more, the outlet supply subsystem is only designed to handle 60W

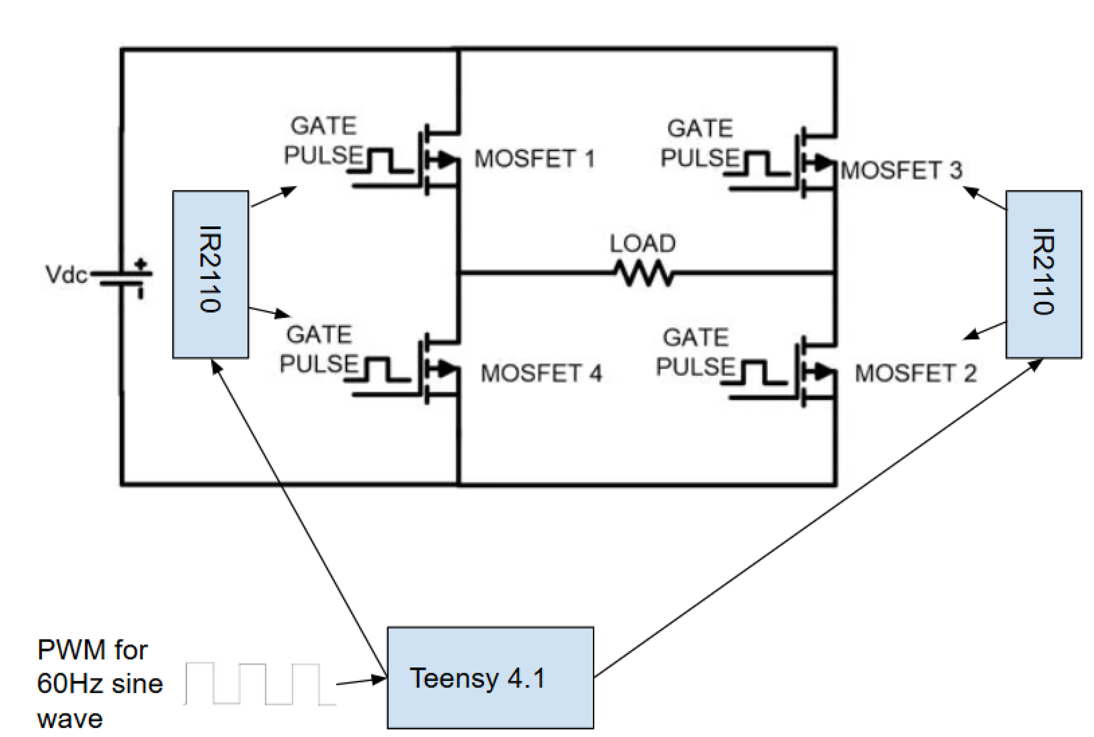

Figure 4. Single Phase Full Bridge Inverter

Results

The main highlights of this project are battery charging, usable USB ports and a 120VAC outlet receptacle.

USB Port:

- The graph shown below displays the output voltage of the USB buck converter being controller at 5V. The yellow line is the voltage seen at the high side output and the green line is the voltage seen at the low side output. The pink line is the difference between the two which is the voltage seen by the USB ports.

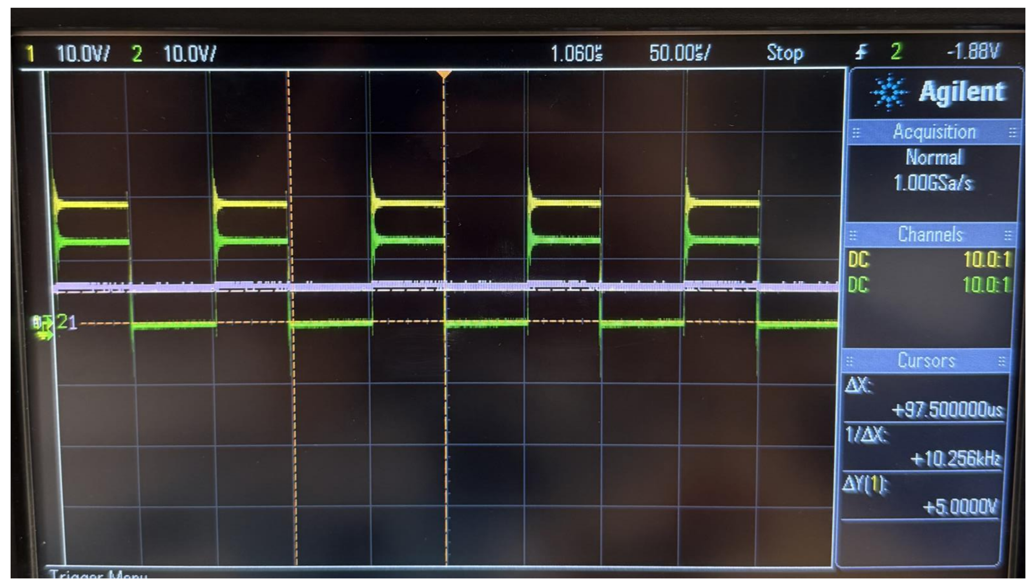

Figure 5. Output Voltage of USB Byck Converter (Yellow: High Side Voltage, Green: Low Side Voltage, Pink: Output Voltage seen by USB ports)

Outlet Supply

- This graph shows the outlet's voltage (in yellow) being held at 120VAC & 60Hz with a 12V DC input. The blue is the input current from the DC supply

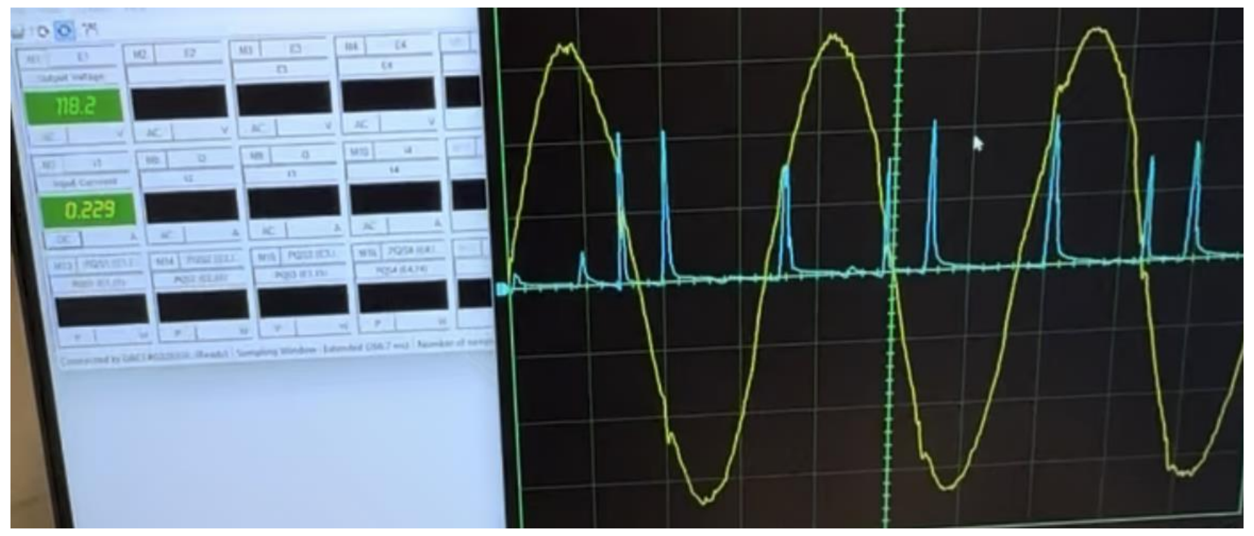

Figure 5. Outlet Receptacle Voltage (yellow), DC input current (blue)

Future Work

- PCBs to reduce size and increase robustness
- The low side buck could be changed to a synchronous buck allowing for easier control and one microcontroller
- A simple screen could be added to show the battery voltage, solar panel data, charging data, etc.

Acknowledgements

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