ATNS Smart Power Supply

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Introduction:

As solar power and other alternative energy sources and becoming more and more economically viable, the issues presented by these sources need to be taken into greater account. Such issues include from the inherently non-linear behavior of systems such as inverters and charge controllers, both of which are crucial components of a photo-electric system. Our design safeguards power systems from such issues by providing a smart barrier that prioritizes renewable sources of energy while keeping such systems electrically separate from primary electrical grids. The ATNS Smart Power Supply's low cost and easy setup allows it to be implemented in both consumer and manufacturing environments, thus incentivizing both the average household and large factories to implement renewable energy sources by providing an extra level of protection that might otherwise be expensive and difficult to implement.

Testing:

Two tests were only able to be conducted due to Covid-19. The first test that was done was finding out exactly how our batteries would discharge with a large resistive load and how the inverter would react over time **Figure 4**. The second test that was done was if we used LED bulbs as opposed to fluoresce bulbs **Figure 5**. Once the tests were both completed, we had a discharge curve for both methods as well as data on how exactly out inverter would behave as well as what type of bulbs we should be using with our final design to maximize our batteries.

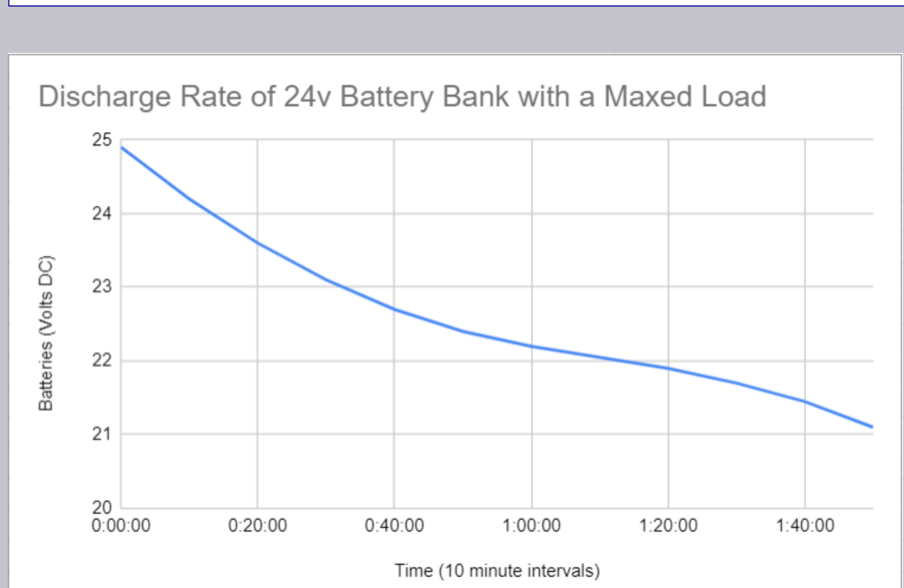

Figure 4: Shows the discharge curve of the batteries with a load 240 Watts. The experiment lasted a little under 2 hours.

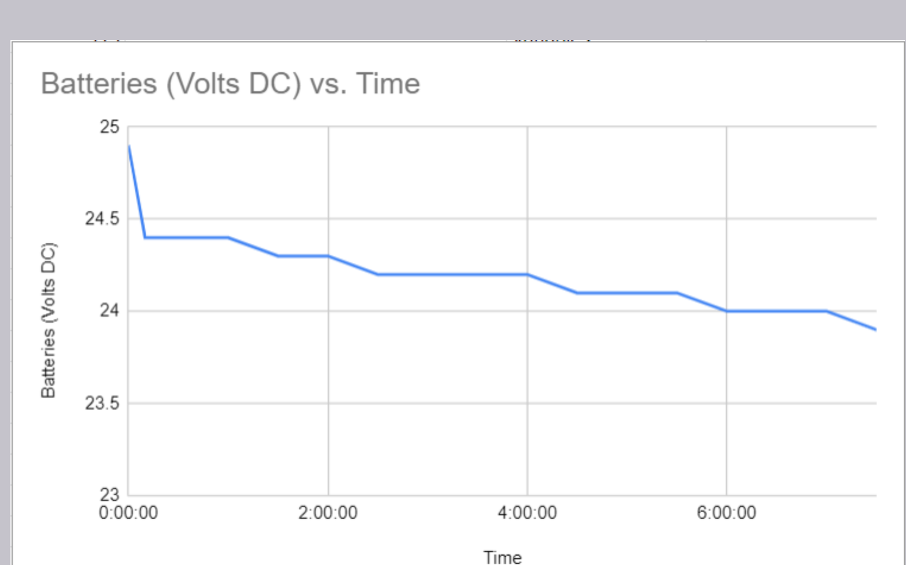

Figure 5: Shows the discharge curve of the batteries with a load 19.5 Watts. The experiment for the LED lights lasted a little under 7 hours before calling it good enough due to the calculated time being closer to 20 hours and 30 minutes

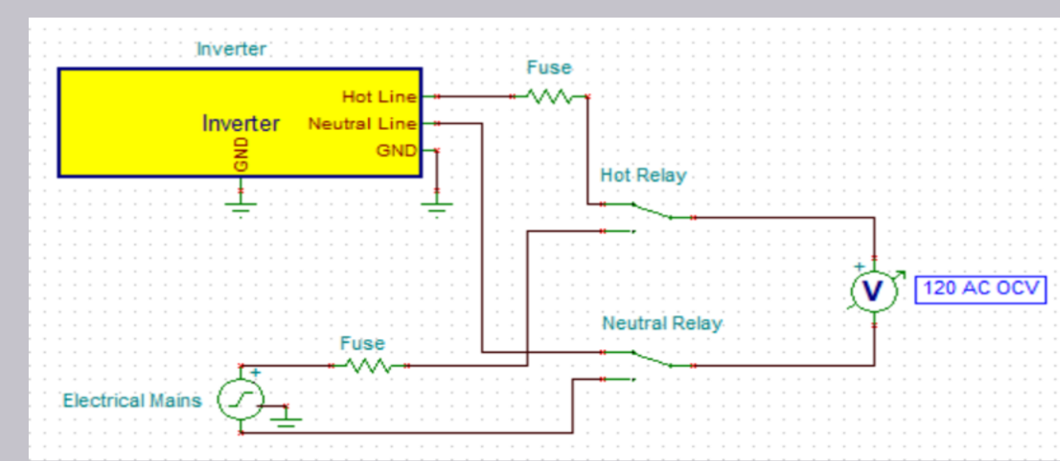

Figure 1: The switching circuit, showing a relay at both the live and neutral connections as to make total electrical isolation between sources.

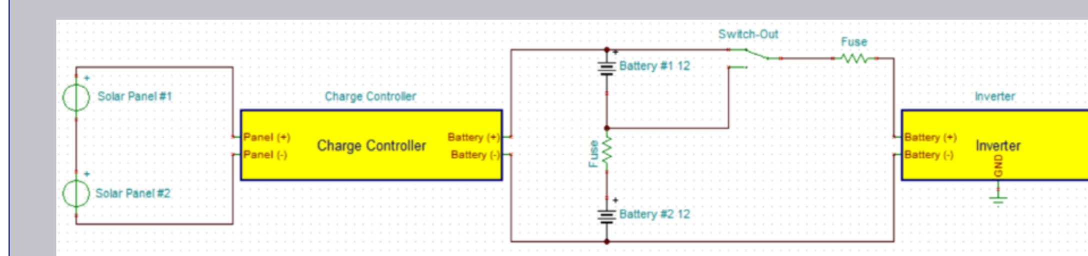

Figure 2: Shows the photovoltaic system with battery disconnect.

Components and Design:

- For the solar panel we used a charge controller, two 100W Panels, two deep-cycle lead-acid batteries and a commercial inverter rated at 300W.
- We used a FRDM KL25Z microcontroller for the center of the project, controlling the switching and reading the battery voltage
- There was a voltage divider with an OPAMP that converted 24v from the lead-acid batteries into 2v so that the microcontroller could accurately read the voltage of the batteries without detonating
- The OPAMP in place between the voltage divider and the rest of the system minimizes loading effects from the voltage divider and microcontroller with the rest of the system.
- Switching between our two sources was accomplished with two SPDT relays that would switch both the live and neutral for the load
- Additionally, there is a disconnect between the two lead-acid batteries as a safety measure to disconnect the batteries in the case of a short, thus preventing fires.
- Finally, there is SPDT switch that allows for one of the two batteries to be switched out, effectively dropping the output voltage to 12v, allowing us to simulate a low output voltage from the panels.

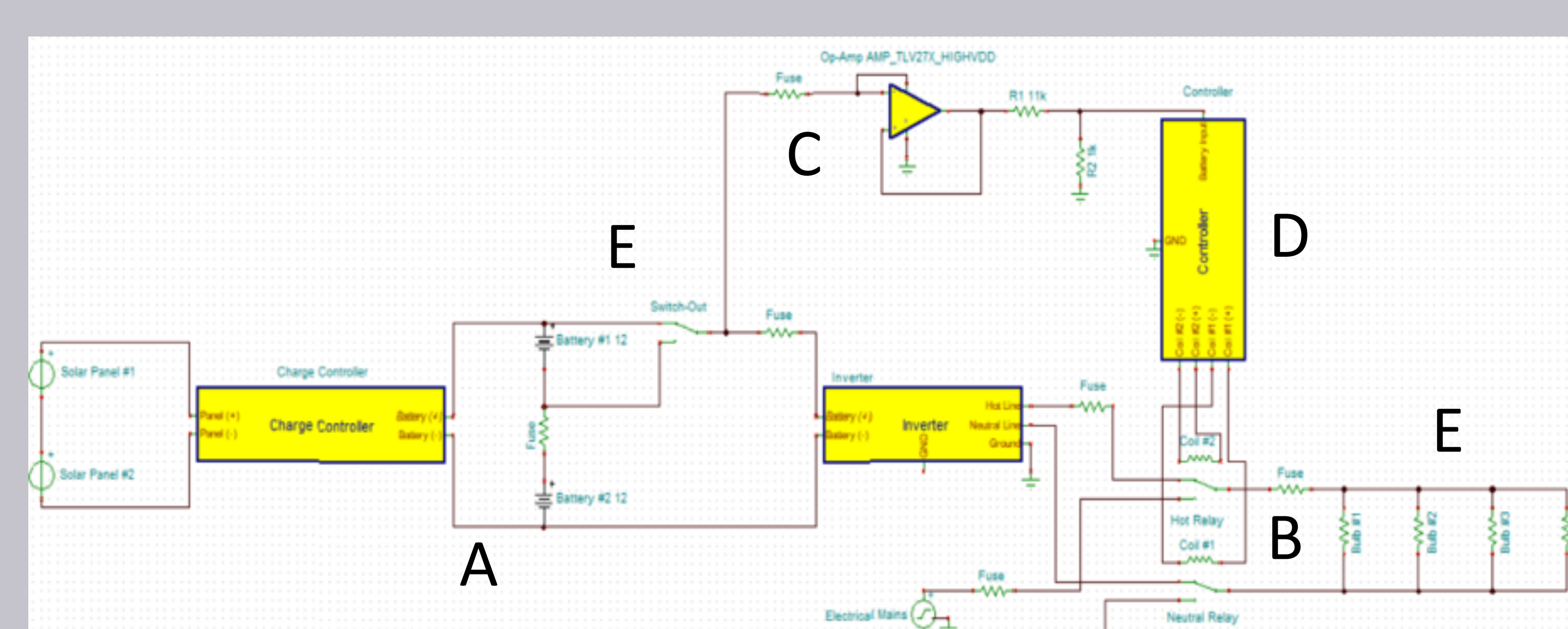

Figure 3: The whole system. The photovoltaic portion (**A**) is on the bottom left, the switching circuit (**B**) is on the bottom,, the voltage divider (**C**) is near the top, the microcontroller (**D**) is at the top right, the battery swap out circuit (**E**) is within the photovoltaic system, and the load (**F**) is on the bottom right.

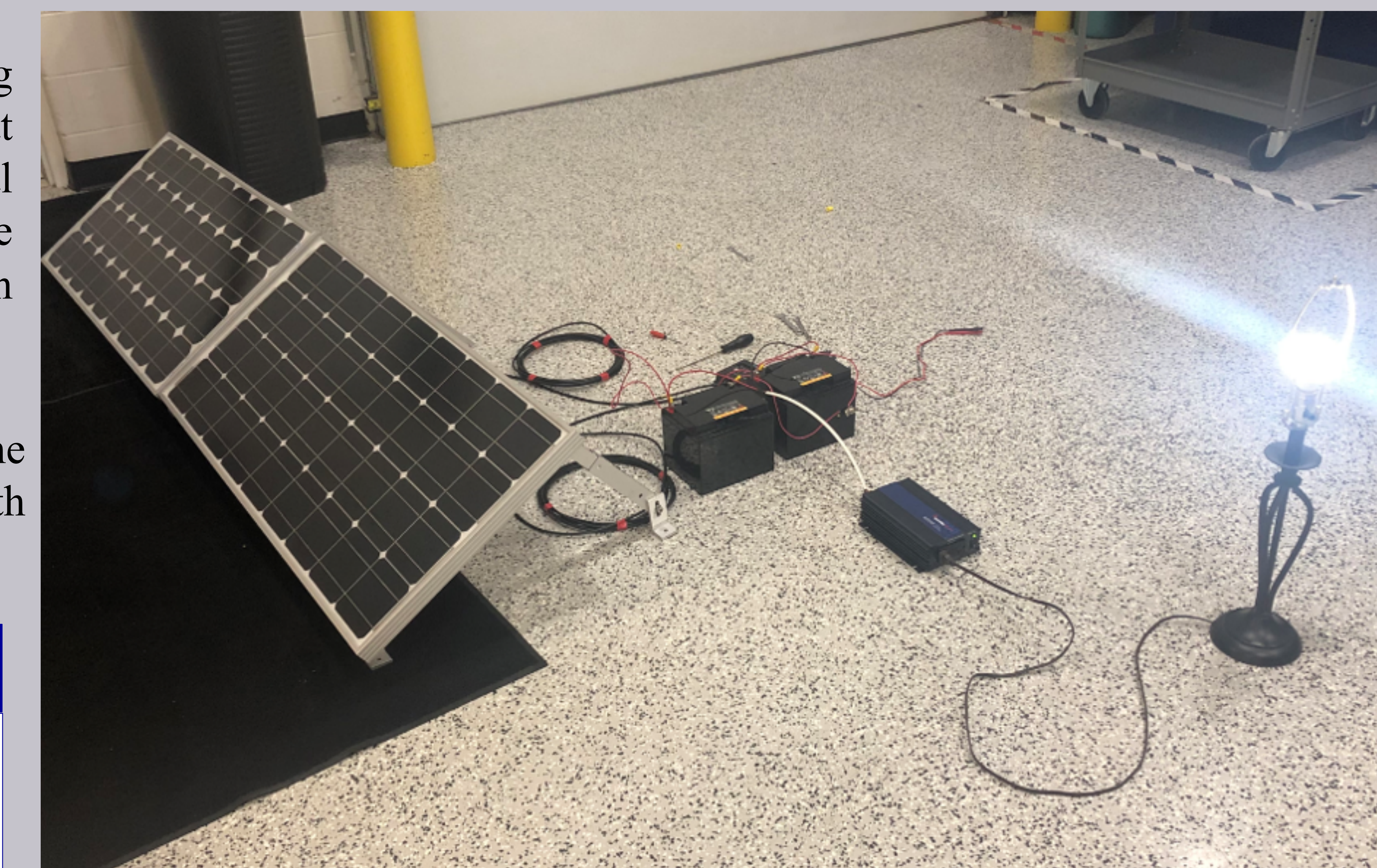

Figure 2: Shows the voltaic system set up and powering a 20W bulb. The panels are on the left, with the batteries and inverter respectively in the middle. On the far left is very clearly our 20W bulb.

Conclusion:

The ATNS Smart Power Supply is a great money saver for a residential use. With the ability to switch between a solar panel system and the electrical mains, one is sure to save money by use of solar energy. Designing the project took some time in the early stages, as figuring out the correct component to switch the sources was time consuming. Through good communication and effort, the group was able to come up with a solution to the switching problem.

Future Work:

The following are ideas to further improve the ATNS Smart Power Supply:

- Constructing a housing to protect the system
- Adding functionality for more than two power supplies
- Creating a more in depth and user-friendly user interface
- Properly designing a buck converter as a DC – DC converter

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