

WT

Pony Treadmill Electrical System

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Goal & Scope

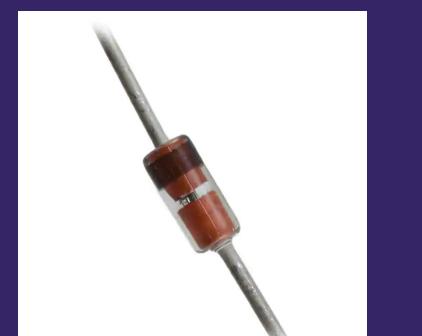
Develop an all-season, self-contained electrical conversion and storage system powered by a Pony Treadmill that is capable of charging small devices in the event of a power grid failure.



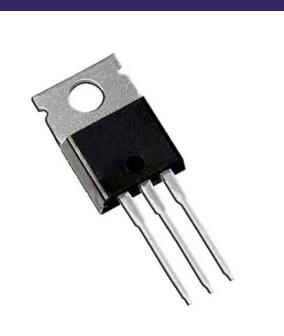
Deliverables:

- Off-grid system that generates electrical power when connected to Pony Treadmill
- System will charge a cellphone when Pony Treadmill is in operation
- Battery will provide 10 hours of cellphone battery charge
- Service Manual provided with system

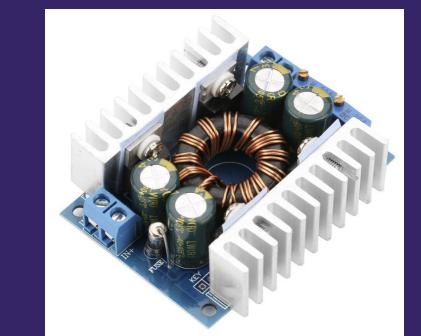
Hardware



Reverse Polarity Protection Circuit



- 55VDC max
- Low resistance - 60mOhm @ 16A
- 10V Gate clamping voltage



- Buck/Boost Converter
- 7 - 32VDC input
- 1 - 30VDC adjustable output
- 10A max current
- Short circuit protection



Isolated DC-DC Converter

- 8 - 17VDC input
- 10 - 15VDC adjustable output
- 18A max output current
- Bluetooth capability
- Overtemp, overload, and short circuit protection

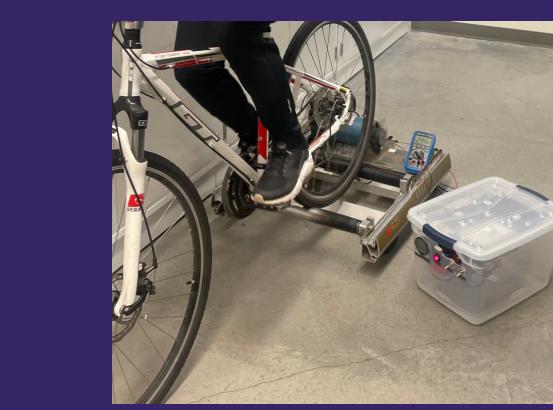
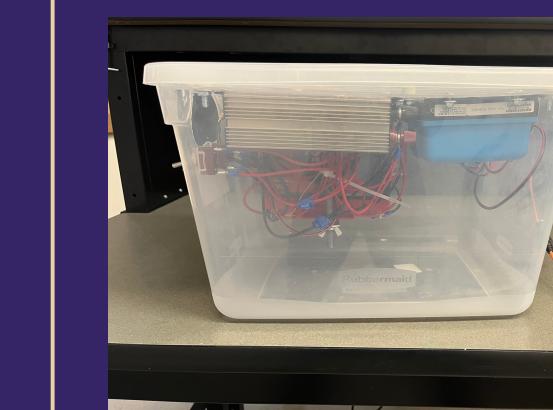


- Battery
- 20Ah Capacity
- Rechargeable
- 3500 cycles at 80% DoD
- 7000 cycles at 50% DoD

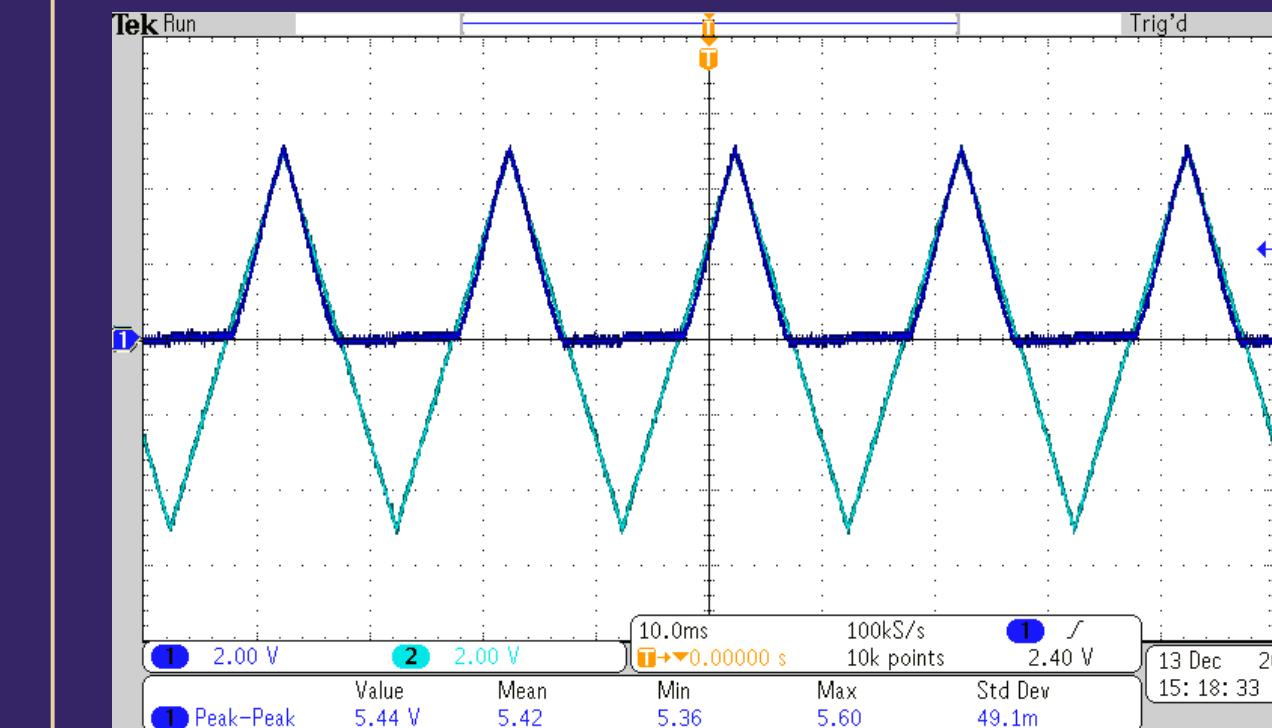


- Pure Sinewave Inverter
- 9.5 - 15.5VDC input
- 110V @ 60Hz output
- Short circuit, undervoltage, overvoltage, and overtemp protection
- USB and universal output ports

Testing & Results



Reverse Polarity Protection Circuit I/O Plot

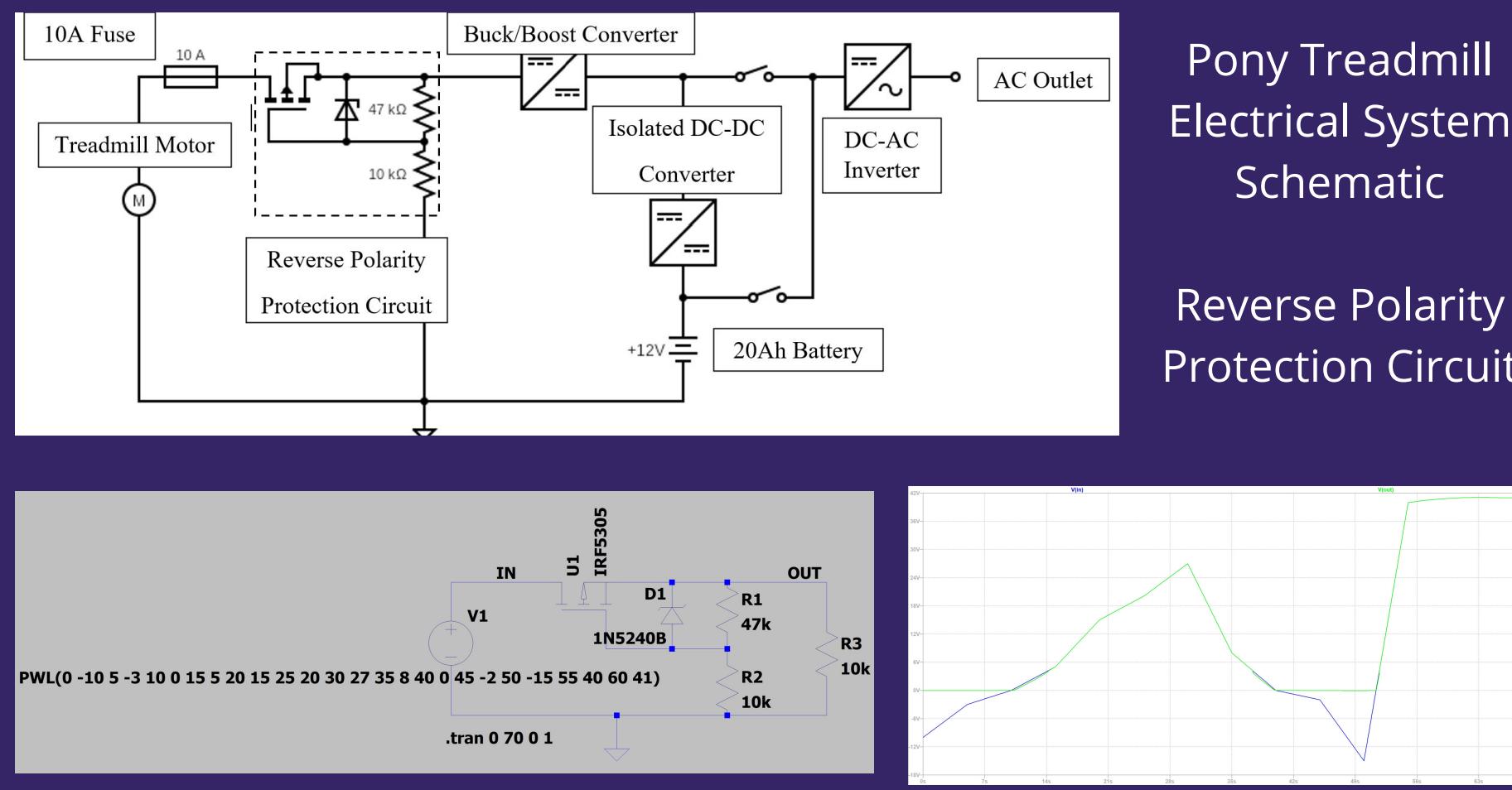


System Specifications:

- 110VAC @ 60Hz output
- 7VDC - 32VDC input
- Battery charger
- Bluetooth connectivity
- Direct device charging capabilities with treadmill operation

Approximate time to completely charge:
Phone via Direct Power ~ 3hrs
Battery Charge ~ 8hrs
Phone via Battery ~ 3hrs

Design Overview



Challenges

- Developing an easy-to-use system that doesn't require an engineering background to operate and maintain
- Creating a modular system whose components can be easily replaced by a non-technical user
- Developing the system without access to a treadmill-trained pony
 - Knowing the typical speed the pony walks along the treadmill
- Containment unit that allows proper ventilation of components while also protecting from weather and pony excreta
- Balance of charging capacity versus pony treadmill endurance
- Budget constraints
 - Desired functionality versus component cost

Improvements

Improvements to our design include:

- Higher amperage capabilities (>10A) for wider range of appliances
- Higher input voltage capabilities/input voltage limiting circuit
- Automated inverter power on/off switching system
- Microcontroller switching unit to automatically determine buck/boost power, battery charging, or battery discharging
- More robust case
- Various quality of life UX improvements