ECE 445 – Senior Design

Project Proposal

Multi-Source, Bi-Directional, High-Power Converter

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Team #29

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I. Introduction

Motivation:

The motivation for this idea is to bridge the gap between power converters and provide a universal platform that allows for multiple functions in an all-in-one convenience package. The current products that are commercially available mainly focus on one type of power conversion (e.g. AC/DC, DC/AC, DC/DC, or AC/AC) and do not allow for much flexibility and user control in terms of input and output. This project aims to meet a broad range of power supply needs both in the household and on the road.

Objective:

The goal is to design a console that can accept three commonly available power sources (12Vdc, 120V/60Hz, 220V/50Hz) and convert any one type into either of the other two. For instance, if the input were 120Vac the user could choose an output of either 12Vdc or 220Vac. This converter will be capable of supplying up to 1,000 Watts in order to meet the demands of critical high-power items such as sump pumps, microwave ovens, refrigerators, power tools, etc., in the event of a power outage or a roadside application.

Benefits:

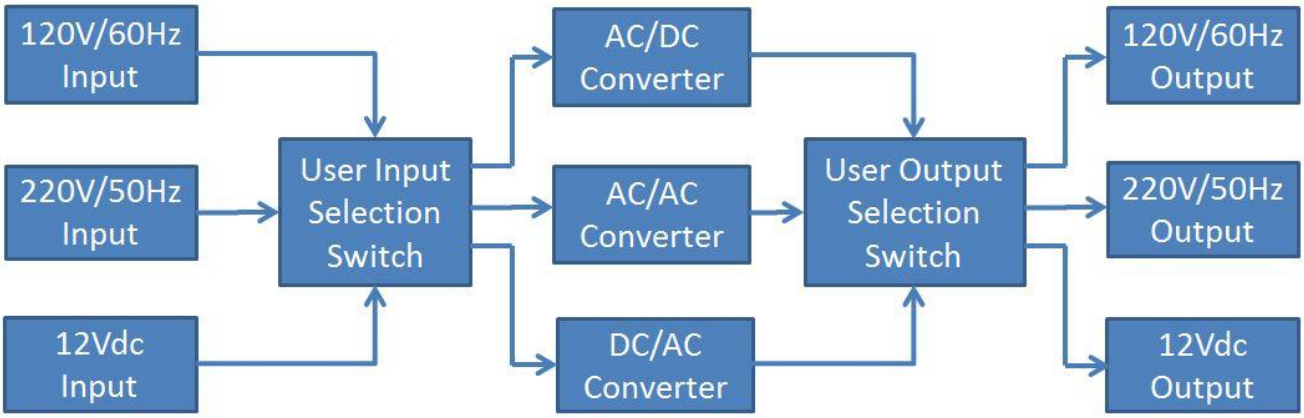
- International compatibility
- User-friendly operation
- Compact design
- Emergency aid

Features:

- Overload protection
- Wide range of inputs and outputs
- High-power applications

II. Design

Block Diagram:



Block Descriptions:

Inputs: Commonly available power sources.

User Input Selection Switch: Selects input source and chooses appropriate converter path.

AC/DC Converter: Takes input of either 120V/60Hz or 220V/50Hz , rectifies it, and steps it down to 12Vdc.

AC/AC Converter: Takes input of 120V/60Hz and steps it up to 220V/50Hz, or takes input of 220V/50Hz and steps it down to 120V/60Hz.

DC/AC Converter: Takes input of 12Vdc and steps it up to either 120V/60Hz or 220V/50Hz.

User Output Selection Switch: Selects desired output and chooses appropriate circuit path.

Performance Requirements:

- Efficiency of 80-90%
- Continuous power handling ability of up to 1,000 W
- Non-continuous overpower handling ability of up to 1,200 W
- ±5% output voltage regulation

III. Verification

Testing Procedure:

The first attribute to be tested will be efficiency. Each conversion process should be no less than 80% efficient, and to achieve this, power loss within individual modules will be examined and minimized. The next test will involve the power handing capabilities of the circuit and will be performed by increasing and recording the size of the load until the overload protection is activated. The last parameter of the circuit to be tested is the voltage regulation, in which varying sized loads will be powered by the circuit and the resultant output voltage waveforms will be examined using an oscilloscope.

Tolerance Analysis:

One of the most important modules of the circuit is the DC/AC converter. This converter will be handling the highest amounts of current since it is responsible for supporting up to 1,000 Watts from a 12Vdc source. When dealing with large amounts of current, components within the circuit such as MOSFETs, inductors, and resistors, can reach unstable temperatures and stop working properly. Careful design consideration is critical when selecting switch frequency, wire gauge, transformer core and windings, and MOSFET resistance. In order to analyze the performance of the DC/AC converter a load will be supplied with the maximum rated power for an extended period of time and heat dissipation will be monitored throughout various components within the converter.

IV. Cost and Schedule

Parts

Description	Supplier	Quantity	Unit Cost	Total Cost
2 AWG Conductor	DigiKey	5 ft	$11.78 / ft	$58.90
12 AWG Conductor	ECE Store	20 ft	$1.40 / ft	$28.00
Connectors	ECE Store	6	$7.00 / pc	$42.00
MOSFETS	DigiKey	16	$5.55 / pc	$88.00
Diodes	DigiKey	16	$0.52 / pc	$8.32
Gate Drivers	ECE Store	2	$0.67/ pc	$1.34
Fuses	DigiKey	4	$2.93 / pc	$11.72

Subtotal = $238.28

Labor

Name	Salary	Hours	Total
Viktor Terziysky	$30.00 / hr	150	$11,250.00
Eric Kapinus	$30.00 / hr	150	$11,250.00

Subtotal = $22,500.00

Total Cost = $22,738.28

Schedule

Week	Description of Task	Group Member
2/6	Research Circuit Parts and Start Proposal	Viktor Terziysky
	Finish Proposal and Meet with Professor Krein	Eric Kapinus
2/13	Circuit Design	Viktor Terziysky
	Circuit Simulations	Eric Kapinus
2/20	Sign Up for Design Review	Viktor Terziysky
	Order Parts	Eric Kapinus
2/27	Assemble AC/DC Converter	Viktor Terziysky
	Regulation for AC/DC Converter and Finish Assembly	Eric Kapinus
3/5	Assemble AC/AC Converter	Eric Kapinus
	Gate Drivers and Regulation for AC/AC Converter	Viktor Terziysky
3/12	Integrate AC/DC Converter & Switches	Viktor Terziysky
	Integrate AC/AC Converter & Gate Driver	Eric Kapinus
3/19	**SPRING BREAK**	
3/26	Assemble DC/AC Converter	Viktor Terziysky
	Gate Drivers and Regulation for DC/AC Converter	Eric Kapinus

4/2	Test, Analyze, and Optimize Converters	Eric Kapinus
	Install Circuit Protection and Help With Optimization	Viktor Terziysky
4/9	Design PCB Layout in Eagle	Viktor Terziysky
	Finish PCB Design and Submit for Manufacturing	Eric Kapinus
4/16	Install Connection Cables	Viktor Terziysky
	Assemble Entire Unit in a Box	Eric Kapinus
4/23	**Demo Preparation and Presentation**	
4/30	**Final Presentation and Report**	