Introduction

• Addresses the growth of external DC converters for consumer products.

• Objective:
  – Modify an AC wall outlet
  – Include two DC power ports:

• Eliminates the need for DC converters outside the wall outlet or in appliances.
Product Features

- Two DC outputs with different power levels options
- Eliminated need of additional power converter
- High efficiency
- In-wall installation
- Simple installation process
Design Overview
Rectifier

- H-bridge rectifier chip
  - convert 120Vac power from the wall to 108Vdc
- Efficiency: 97.37%
- Ripple: ±1.7V
  - With capacitor bank of 156µF
- Waveform:
  - Channel 1 Output Voltage
  - Channel 2 Input Voltage from the Function Generator
Linear Regulators

- **Design:**
  - Used two linear regulators
  - Step down from 108V to 75V
  - Step down from 75V to 12V
  - Avoid over stressing the components

- **Waveform:**
  - Input 25 V from DC power supply.
  - Pot adjusted to voltage.
  - Range from 20V-8V tested.
FLYBACK CONVERTER
Flyback Converter

• Provides:
  – galvanic isolation between the output and input
  – an additional layer of surge protection

• Ratings:
  – Input: 108V/3 A
  – Output: 25V/8.1 A
Flyback MOSFET Control

- Waveform of PWM control signal for the flyback converter
Flyback Converter Challenges

- **Top Waveforms:**
  - Noise on the switching signal

- **Bottom Waveforms:**
  - Floating ground

- **Channels:**
  1. Second voltage regulator output
  2. First voltage regulator
  3. Bridge rectifier output
  4. Switching signal (not on differential probe)
LOW BUCK CONVERTER
Low Buck Converter

• Ratings:
  – Input: 25V/1A
  – Output: 5V/5A
  – Switching Frequency 300 kHz
Low Buck Control

- Used IC chip: TSP5450
- Included the MOSFET and controls for linear regulations
  - Voltage output regulated itself to be 5V
Low Buck Output

- Average Voltage: 5V
- Ripple: ± 100mV
- Waveform:
  - Low buck converter with an electronic load.
  - The electronic load with set output current of 4.75A
  - Channels:
    1. Input Voltage
    2. Output Voltage
    3. Output Current
Efficiency Curve

- Average Efficiency is 80.3%
HIGH BUCK CONVERTER
High Buck Converter

- Rating:
  - Input: 25V/7.2A
  - Output: 12V/15A
  - Switching Frequency 115 kHz
High Buck Control

• Original Idea:
  – TI Buck Controller (TPS40020)
  – Over Current Protection mode

• Alternative Approach:
  – PWM (UC3843)
  – High Side Gate Driver (IR2117)
High Buck Output

- Waveform:
  - loaded with drill 25V input from DC power supply.
- Channels:
  1. Voltage output (unadjusted)
  2. Gate signal
  3. PWM output
  4. Input Voltage load drawing 3.5A
Efficiency Curve

- Average Efficiency is 88.93%
Loads
Wall Construction
Overall Results

• Each PCB worked
• Problems with Flyback PCB
• 100% operational Buck Modules
Lessons Learned

- Check Circuit (signals)
- Ground
- Don’t plug in the circuit with power on during the demo
- Cindy is a good cook
Future

• Smaller Components
  – Potentiometers, higher switching frequency, inductor, PCB layout
• Lower ESR Capacitors
• PCB High Buck
• Commercialize

The Battle Continues…
Questions