

Compact DC/AC Power Inverter

Design Day - Fall 2014

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- Introduction to Power Inverters
- Motivation and Goals
- Design Specifications
 - *Little Box Challenge*
 - Chosen Parameters
- Final Design
 - Self Assessment
- Future Suggestions
- Demonstration and Questions

- Convert DC to AC
 - Power devices
 - Supplement grid
- Variety of sizes & applications
 - Solar, portable power, etc.
- Design constraints:
 - Size, efficiency, power density

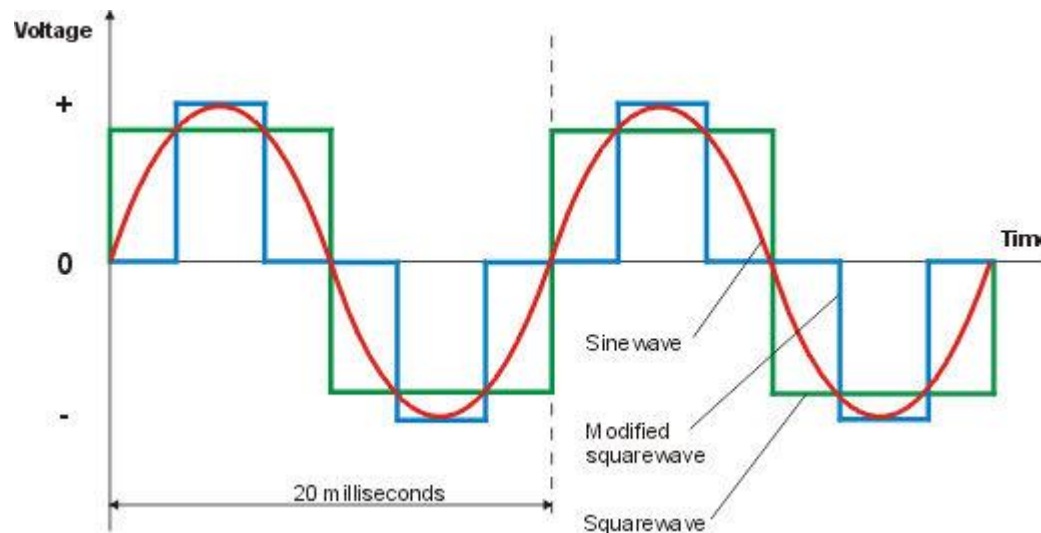


http://en.wikipedia.org/wiki/Power_inverter

- Opportunities from Industry
- What could a new design mean?
 - Better stand alone systems
 - Greater efficiencies
 - Solar power generation



- Falling panel prices, stagnant inverter prices
- Easy to find room for tissue box sized device
- Modified sine waves are “sloppy”



<http://www.theengineeringprojects.com/wp-content/uploads/2012/11/Pure-Sine-wave-Inverter-With-Code3.jpg>

- New technologies provide more design choices
 - Silicon Carbide
 - Gallium Nitride
- Inexpensive, open-source availability
 - Free Libraries
 - Extensive Support



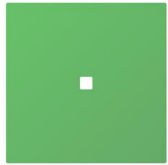
<http://www.cree.com/power/littleboxchallenge>

Chosen MOSFET



<http://arduino.cc/en/Trademark/CommunityLogo>

Arduino Logo



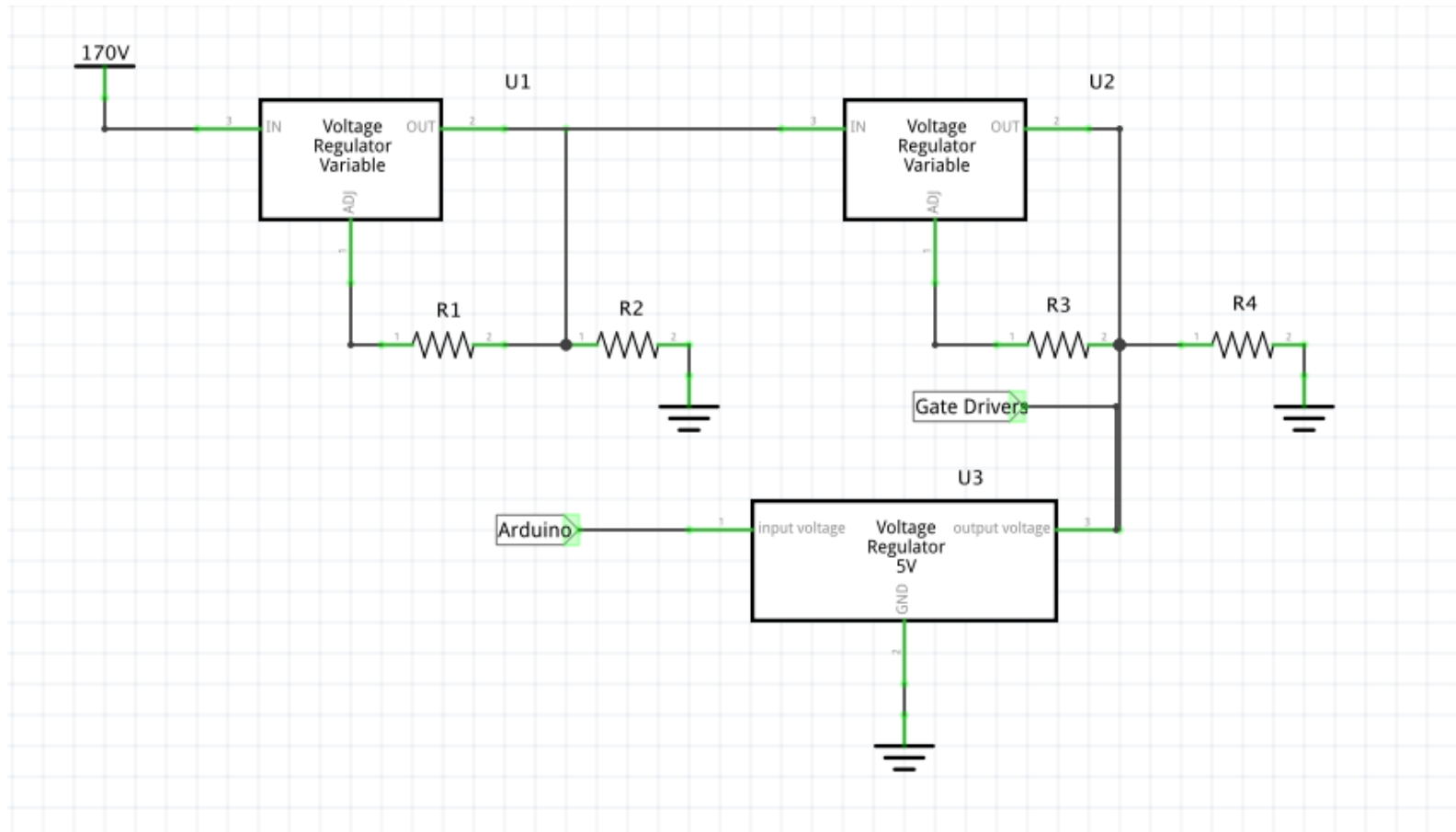
LITTLE BOX CHALLENGE



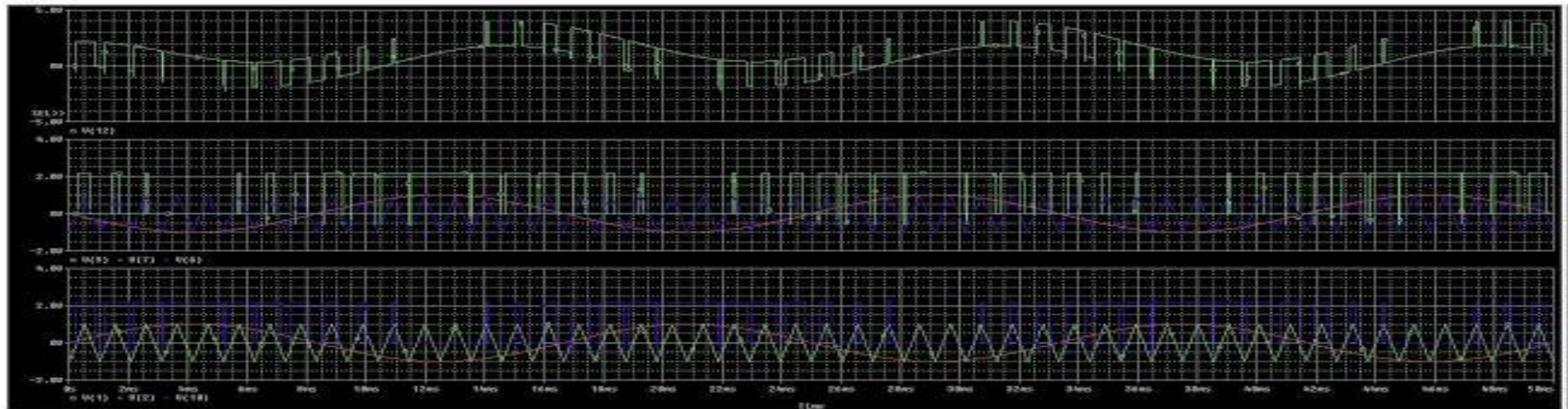
Parameter	Requirement (Nominal)
Maximum Load	2 kVA
Power Density	> 50 W/in ³
Volume	< 40 in ³
Voltage Input	450 V DC
Voltage Output	240 V RMS AC
Frequency Output	60 Hz
Maximum Outer Temperature	< 60 °C
Electromagnetic Compliance	FCC Part 15 B

DEPARTMENT OF ECE
ELECTRICAL AND COMPUTER ENGINEERING

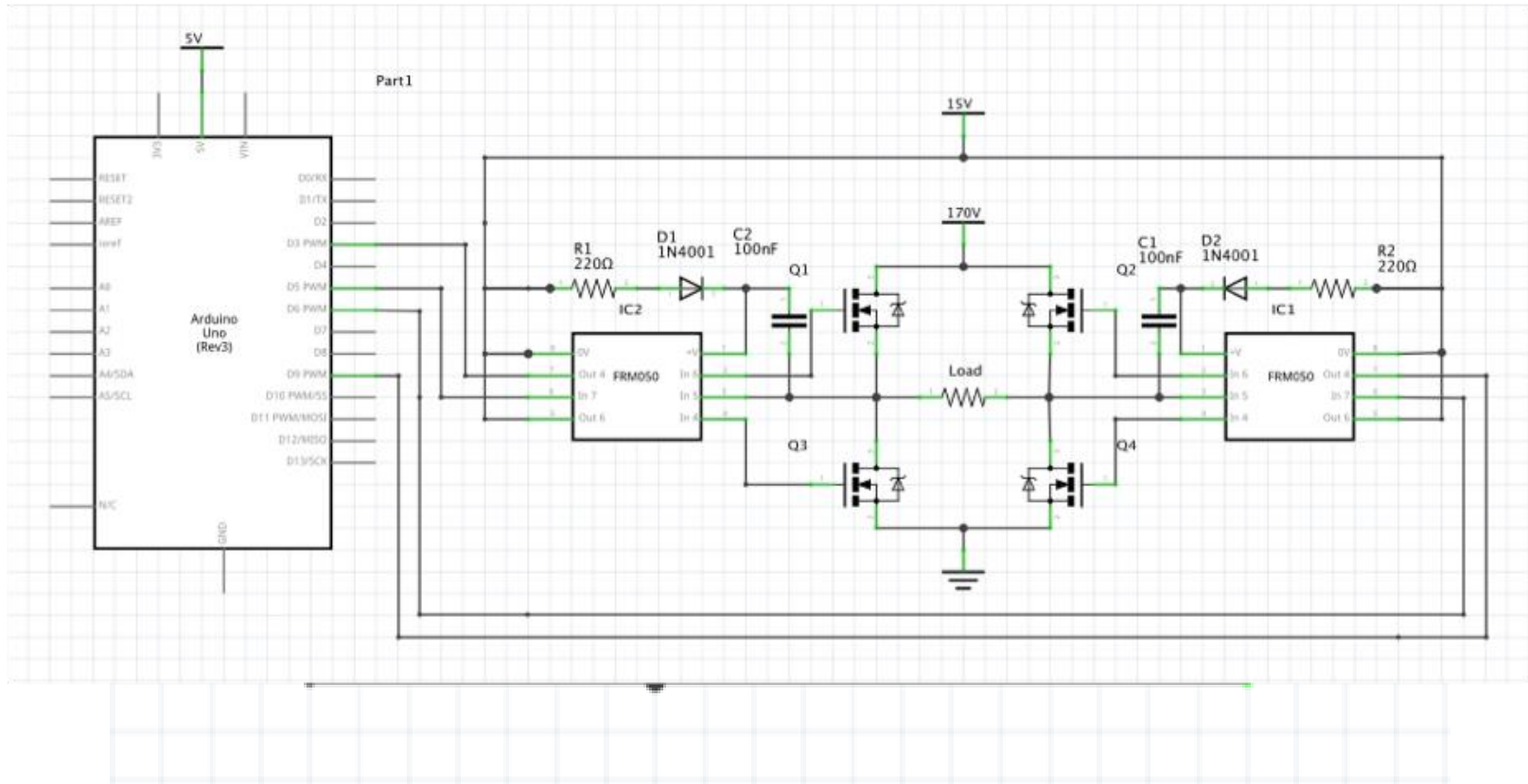
Parameter	Requirement (Nominal)
Maximum Load	1 kVA
Power Density	> 25 W/in ³
Volume	< 40 in ³
Voltage Input	200 V DC
Voltage Output	120 V RMS AC
Frequency Output	60 Hz
Maximum Outer Temperature	< 60 °C
Electromagnetic Compliance	FCC Part 15 B



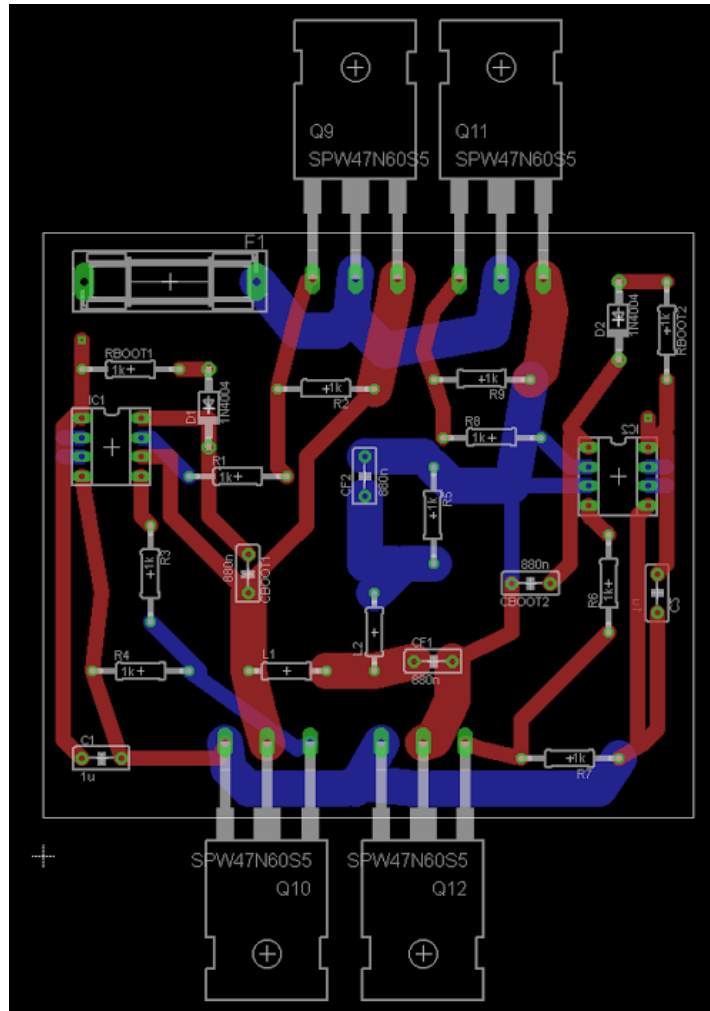
DC-DC Conversion



Pulse Width Modulation

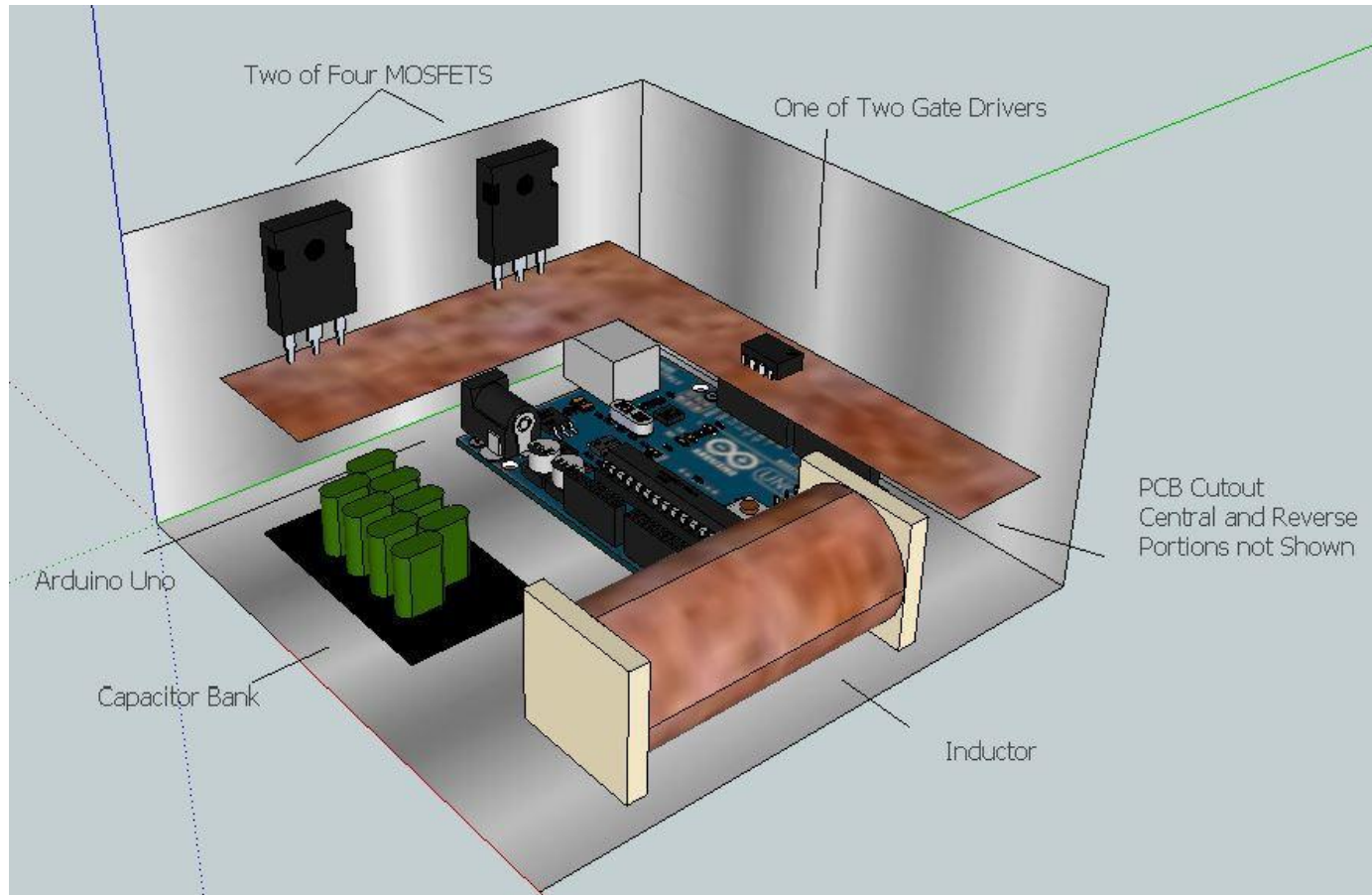


H Bridge



Final Printed Circuit Board Layout
3" x 3.3"

- Board Size
- Trace widths
- Vias



Initial Enclosure Layout



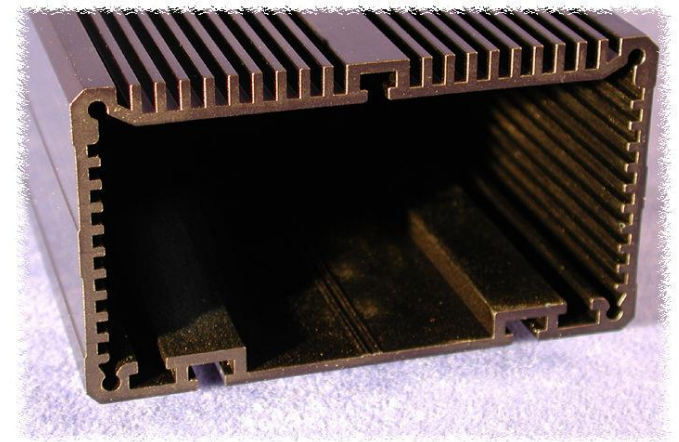
Inductor Enclosure



Final Layout

Item	Price	Quantity	Total	Description
C2M0025120D	\$71.99	4	\$287.96	Silicon Carbide MOSFETs
FAN7382	\$3.75	2	\$7.50	600 Volt Gate Driver
DC-DC Converters	\$2.02	2	\$4.04	Supply Rail for Micro Controller
LM2940	\$1.65	1	\$1.65	5V Regulator
Enclosure	\$24.37	1	\$24.37	Aluminum Enclosure
ATMega328	\$4.95	1	\$4.95	Arduino Microcontroller
PCB	\$0.00	1	\$0.00	Printed Circuit Board from ECE Shop
		TOTAL:	\$330.47	

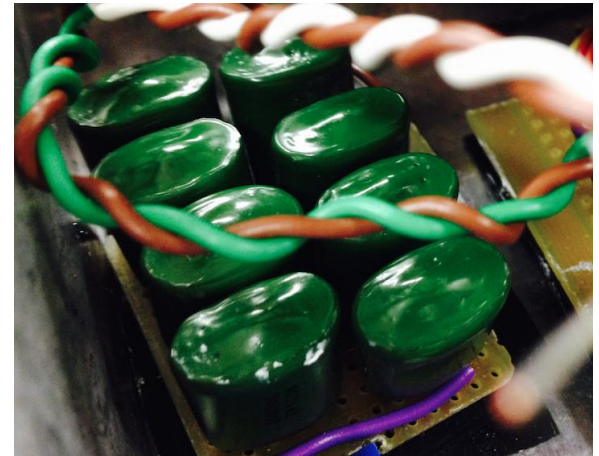
- Better materials
 - Heat sinks
 - Plating
- Milled Enclosure
 - PCB Guides
 - Dissipation fins



- Contain H Bridge, filter, processor, and DC/DC converter on same PCB
- Use surface mount over DIP components
 - Smaller, contain multiple parts
- Port placement
 - Transistor closer to edge



- Current filter designed for smaller loads ($\sim 400\text{W}$)
- 1 capacitor over capacitor bank
 - High voltage
- Increase inductor wire diameter
- Isolation transformer



- Education
 - The process
 - Technical integration
- Self Assessment
 - Shortcomings
 - Successes
- Thank you



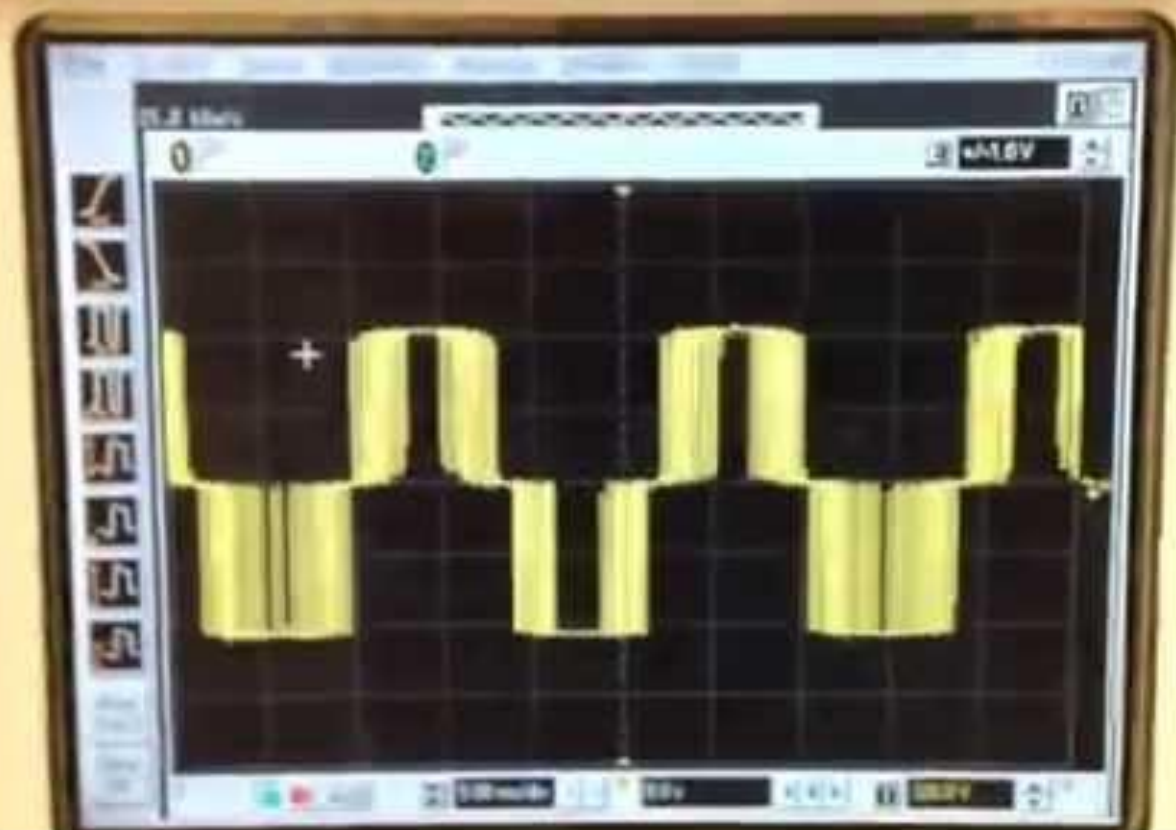
Now, time for a video demonstration...

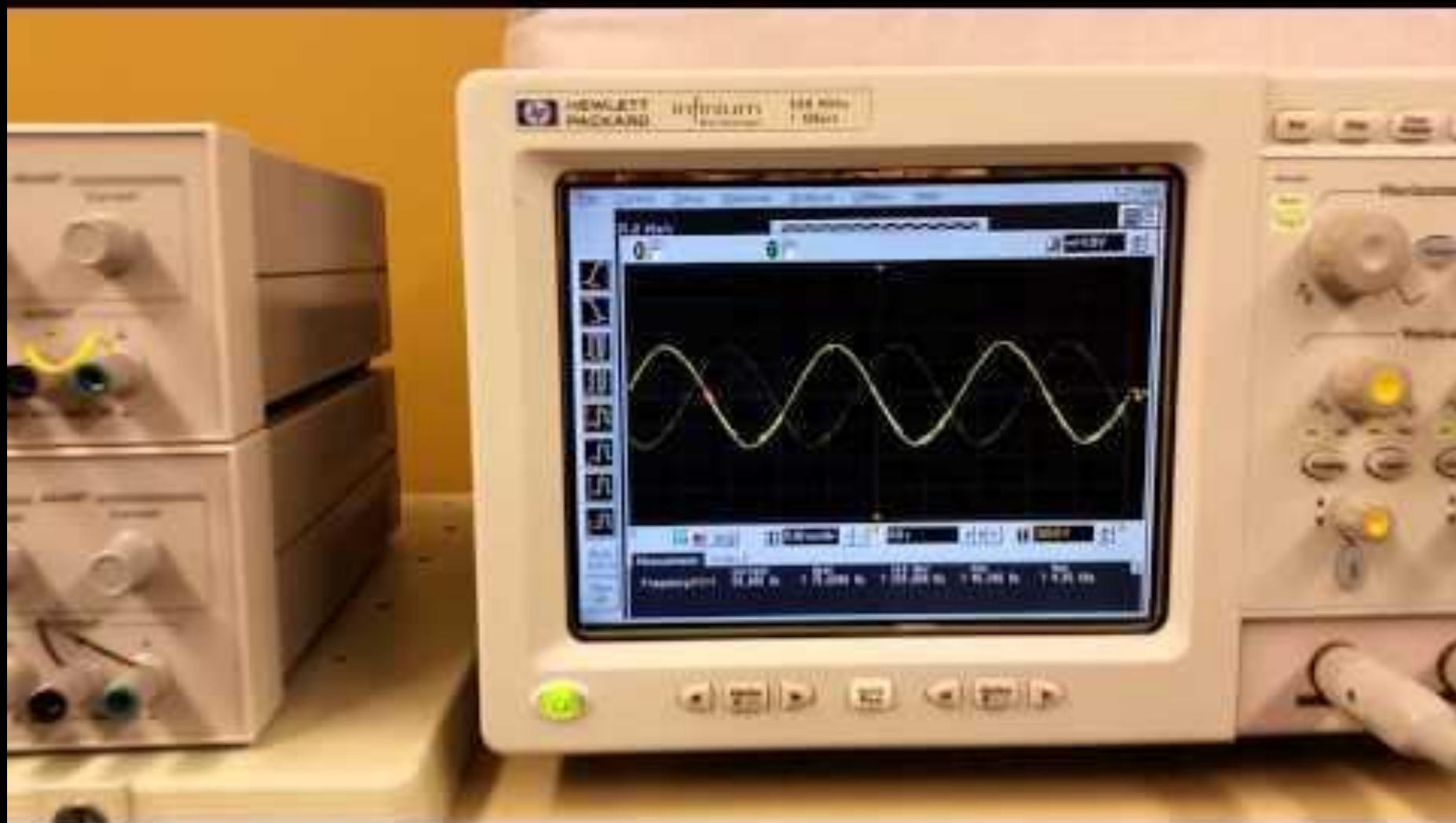


HEWLETT
PACKARD

infinium

500 MHz
1 GS/s





Questions?