

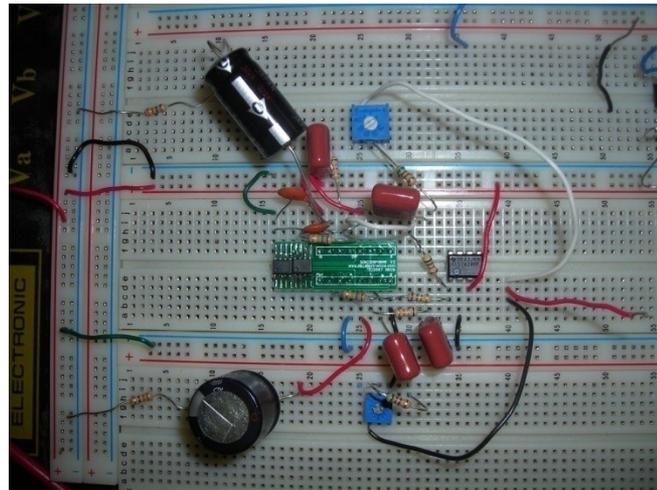
# High-Efficiency Headphone Amplifier

Mike DiVirgilio

Mike Daugherty

Sean Evanuk

Kevin Packer



# Outline

- Introduction
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- Schematic
- Circuit
- Material Costs
- Achievements
- Conclusion

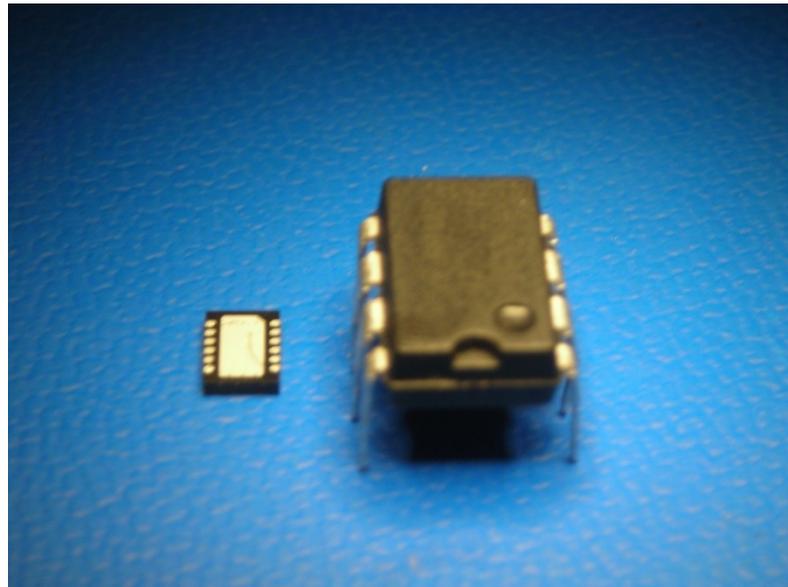
# Introduction

- Problem: Poor sound quality in portable music players
- Objective: To design a higher power headphone amplifier with minimal power consumption
- Basic Requirements: Provide 100mW of power to a pair of 32 ohm headphones using two AAA batteries



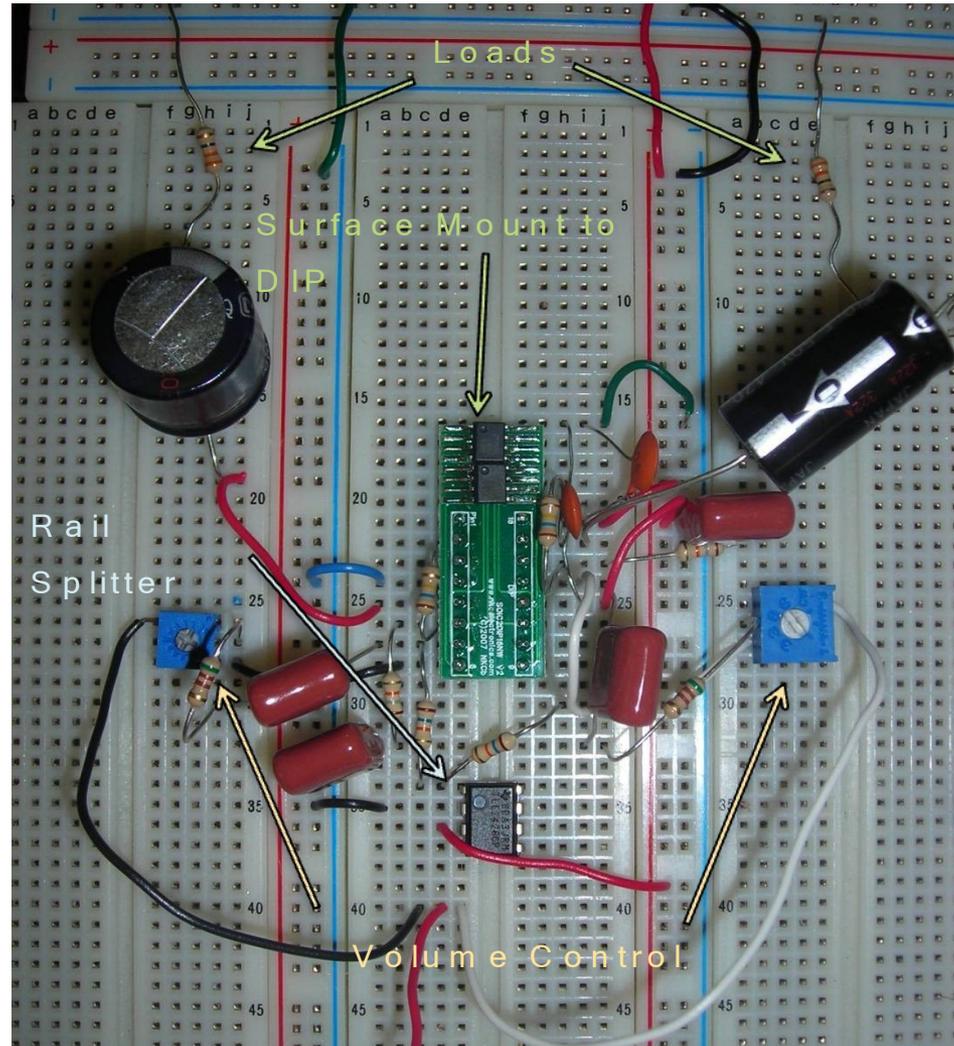
# Design Approach

- Non-inverting op-amp using minimal power consumption
- Boost converters used to meet output power requirements
- Used uni-polar supply to minimize converter losses





# Circuit

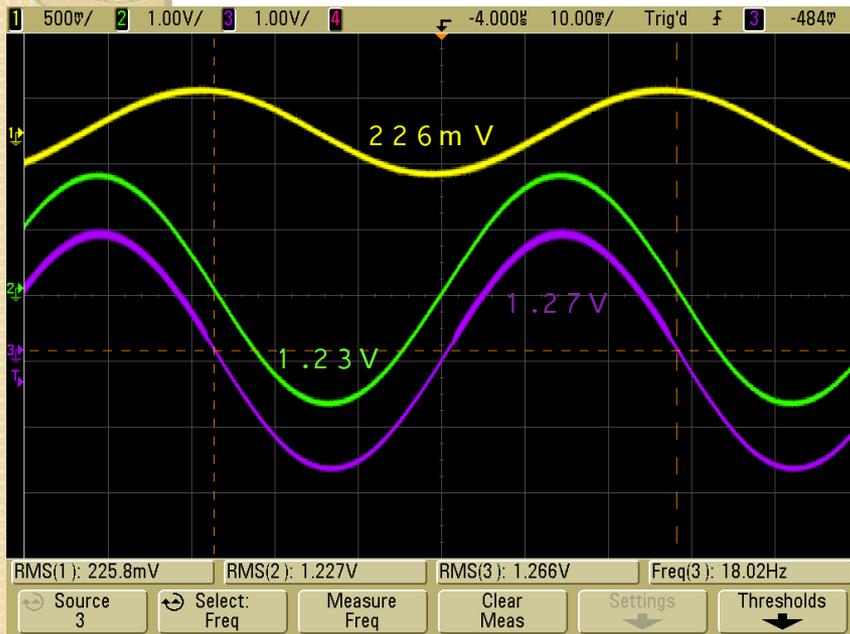


# Material Costs

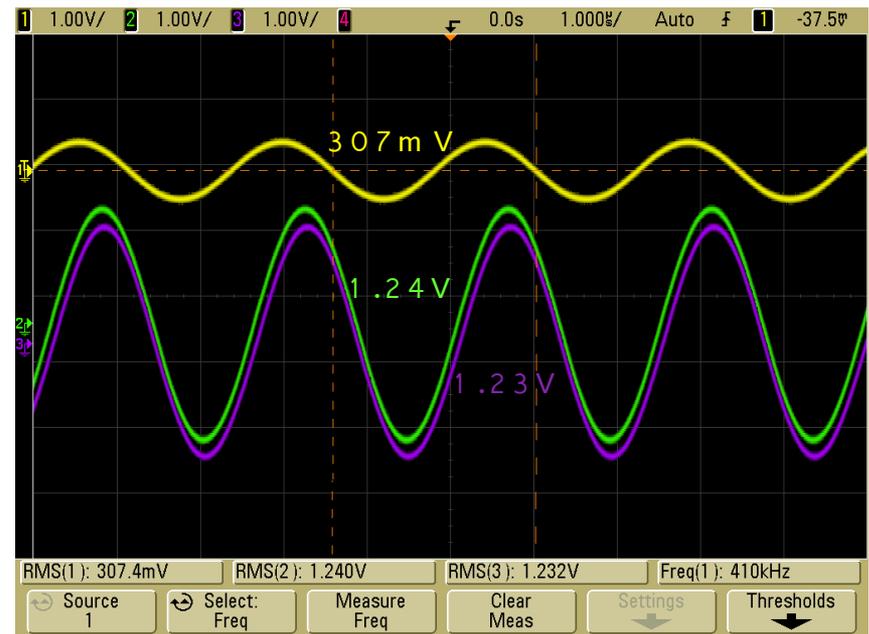
Part	Quantity	Unit Price	Price
LMH6642 op amp	2	\$ 0.8060	\$ 1.6120
LTC3459 DC/DC converters	2	\$ 2.8700	\$ 5.7400
TLE2426 Rail Splitter	1	\$ 0.6000	\$ 0.6000
10k potentiometer	2	\$ 0.5000	\$ 1.0000
1uF cap	4	\$ 0.1980	\$ 0.7920
100nF cap	2	\$ 0.1700	\$ 0.3400
16k resistor	2	\$ 0.0048	\$ 0.0095
18k resistor	2	\$ 0.0048	\$ 0.0095
160k resistor	2	\$ 0.0048	\$ 0.0095
470uF cap	2	\$ 0.7000	\$ 1.4000
CP-3533NGS-ND 1/8" headphone jack	2	\$ 0.6042	\$ 1.2085

# Results - Frequency Range

18Hz



410kHz



Yellow : Input Signal  
Green : Left Channel  
Purple : Right  
Channel

# Achievements

Requirement	Original Goal	Final Result
Max Output Level	100mW	98.5mW
Output Impedance	3.2 $\Omega$	
Frequency Range	20Hz - 20kHz	18Hz - 410kHz
Frequency Response	+/- 1.0dB	+/- 3dB
Nominal Gain	20dB	15.5dB
Gain Adjustment Range	30dB	>30dB
THD @ 10mW	0.1%	0.301%
THD @ 100mW	1.0%	0.396%
Noise Density at Output	-128 dBV /sqrt(Hz)	-124 dBV /sqrt(Hz)
Power Consumption	400mW	400mW (w/89% efficient converters)
Battery Life	90 Hours	90 Hours
Materials Cost	\$40	\$12.72

# Conclusion

- Met power consumption requirements at 98.5mW
- Frequency range much wider than the audible human range
- Low cost
- Future improvements include addition of converters, filtering for noise reduction, and stereo volume control.