# An Introduction to BriteSound™ Audio

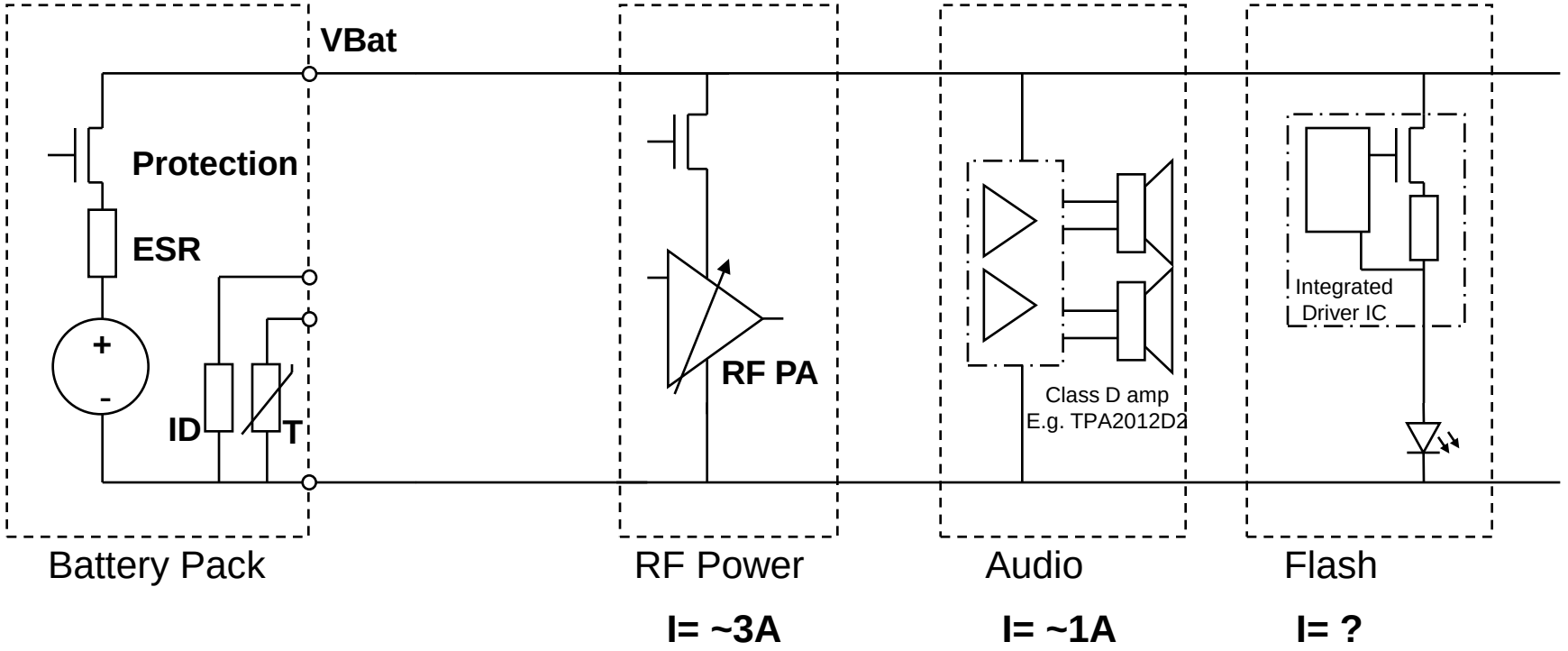
## Supercapacitors in Portable Multimedia Players & Accessory Audio

March, 2009

# Who is CAP-XX?

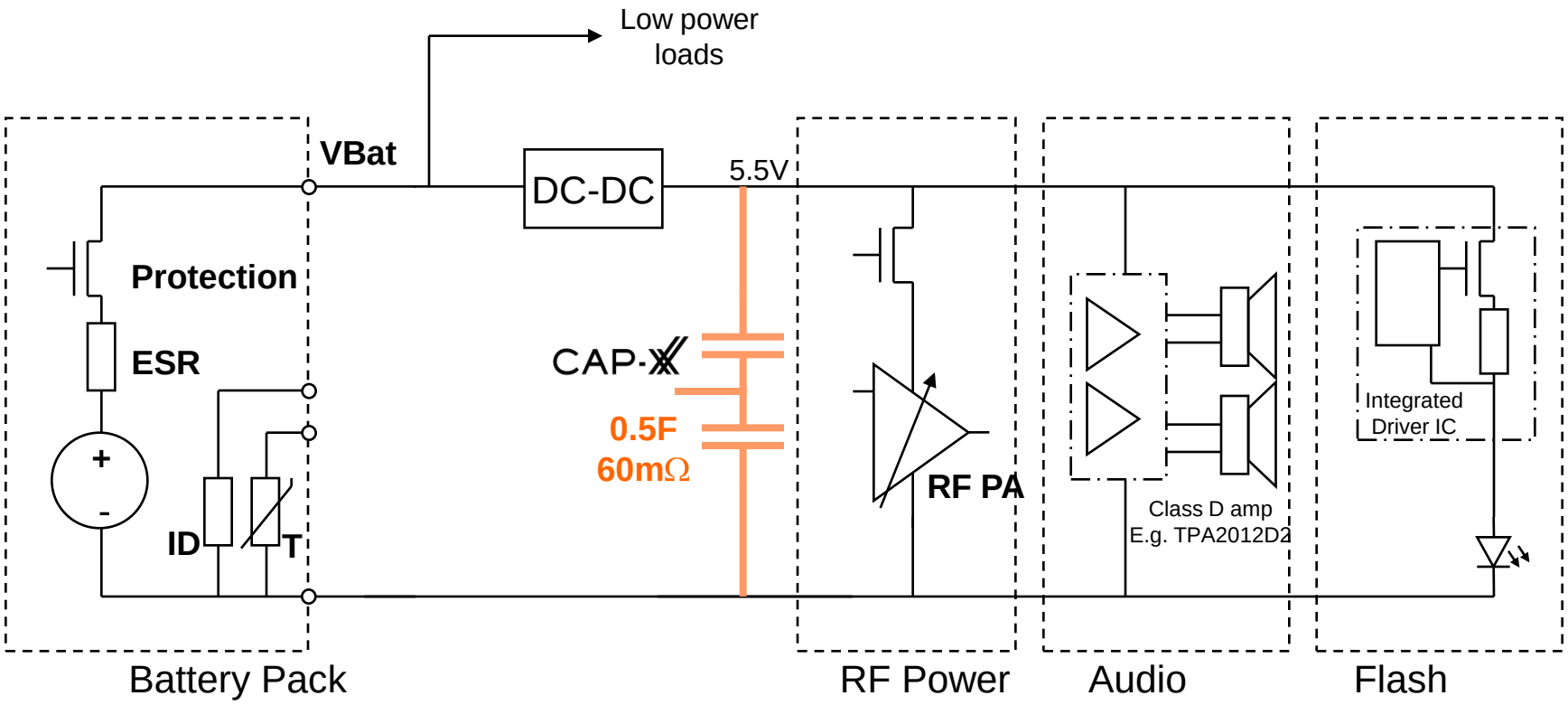
- Market-driven electronic components manufacturer
- World leader in thin, flat, small supercapacitors
- Our products deliver a number of benefits to enhance the performance of mobile multimedia devices
  - BriteFlash™ for a brighter flash & better photos
  - BriteSound™ for louder, clearer audio output
  - BritePower™ for improved battery performance

# The Power Problem




- High current loads on battery are completely asynchronous
- Several may require power at same time
- As battery discharges, current to constant power loads increases
- Battery pack ESR can be >100mΩ with a current limit of ~3A

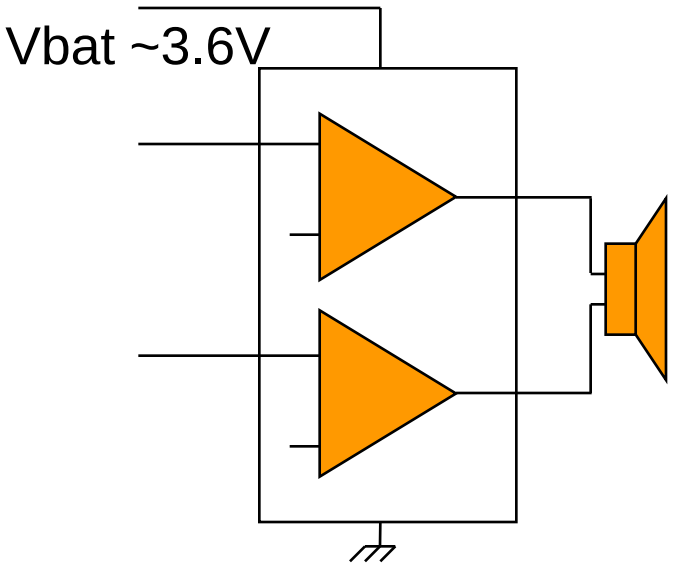
# The CAP-XX Solution

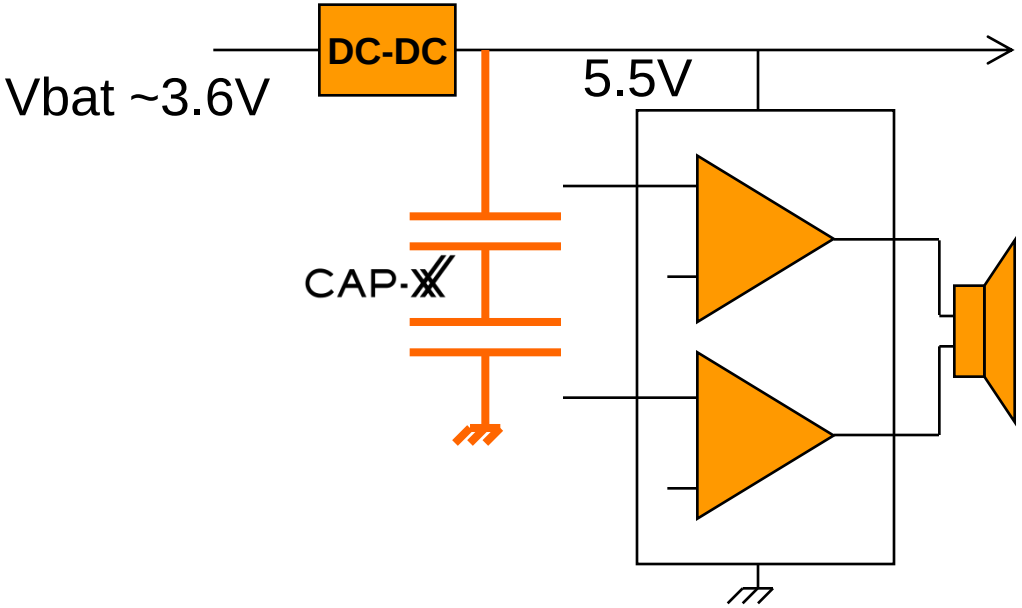



- High capacitance, low ESR supercap provides bulk energy storage to buffer a high power supply rail
- Battery & DC-DC supply average power, supercap supplies peaks

# Supercap Drives Audio

- Maximum power per channel = $V^2/R = (Vbat)^2/speaker\ impedance$
- Boosting from 3.6V across the battery, to 5.5V from the supercap, delivers a 6db increase in speaker power



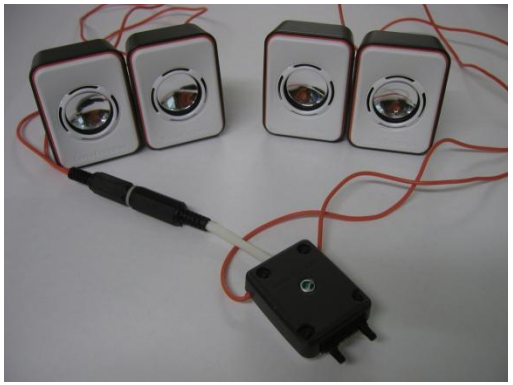

**1.62W/channel with 8W speakers**
3.24W/channel with 4W speakers

3.125W/channel with 8W speakers
**6.25W/channel with 4W speakers**

# The BriteSound™ Advantage

- More power
- More volume
- Better bass response
- Less interference/noise (from eg, mobile phone calls)
- Support for hard disk drives (spin-up)
- Improved battery performance (especially if “old” or “cold”)
- Support for other high power functions (eg, LED flash in devices with a camera, RF PA in phones, OLED screens, etc.)

- All in a very small, thin package

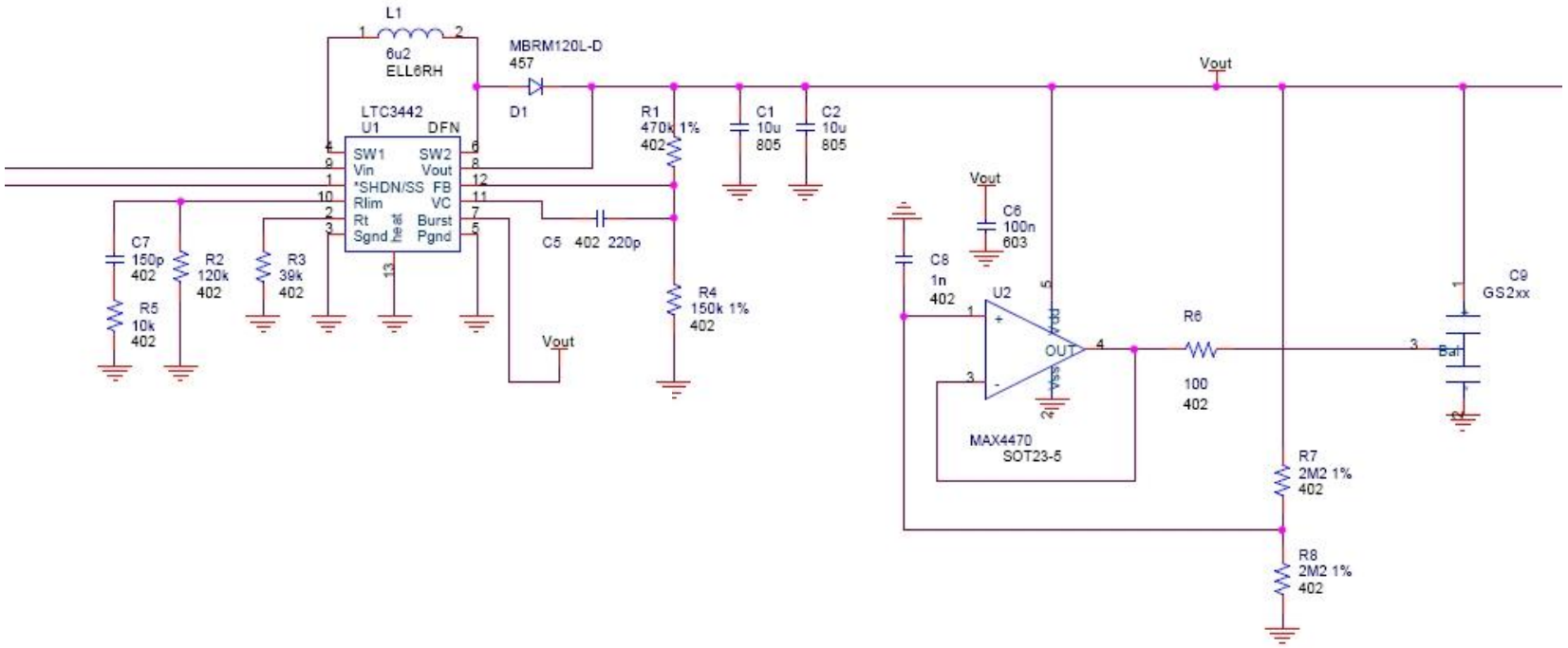


# Test & Demo Setup

- CAP-XX modified a set of SEMC MPS-60 speakers:
- Increased audio amp gain
- Added DC-DC boost converter to charge supercap
- Powered existing amplifier from 5.5V supercap
- Set current limit to ensure compliance with spec

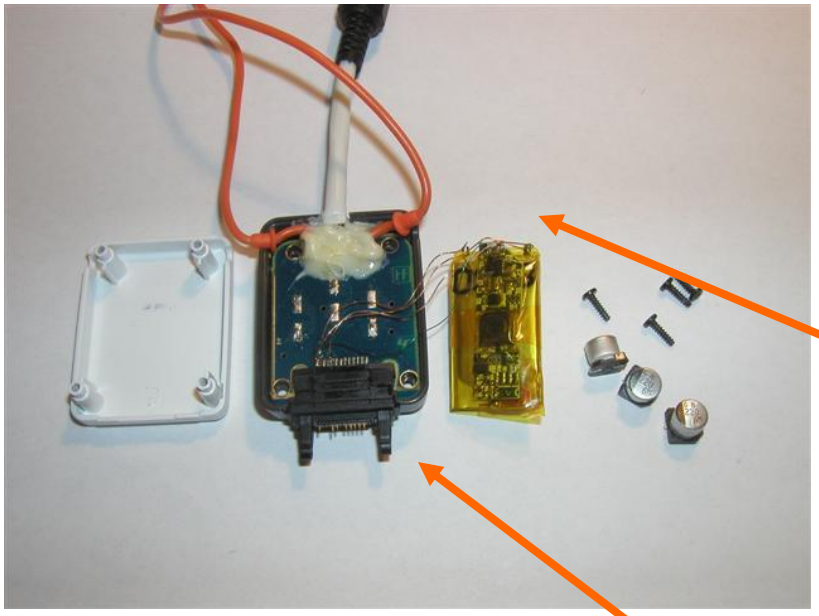
| Parameter | Prerequisite | Value | Unit |
|---|---|---|---|
| $I_{DCIO\_SCOURCE\_OFF\_LEAK}$ | Short circuit DCIO - DGND current when no accessory identified | < 50 | µA |
| $I_{Average}$ | | ≤ 0.5 | A |
| $I_{peak}$ | $t_{peak\ duration}$ | ≤ 0.7 | A |
| $t_{peak\ duration}$ | | 100 | ms |
| $I_{max\_pwr\_source}$ | Accessories using current between $I_{Average}$ and $I_{max\_pwr\_source}$ shall by keying be forced to be connected directly on the phone (see comment below) | < 1 | A |

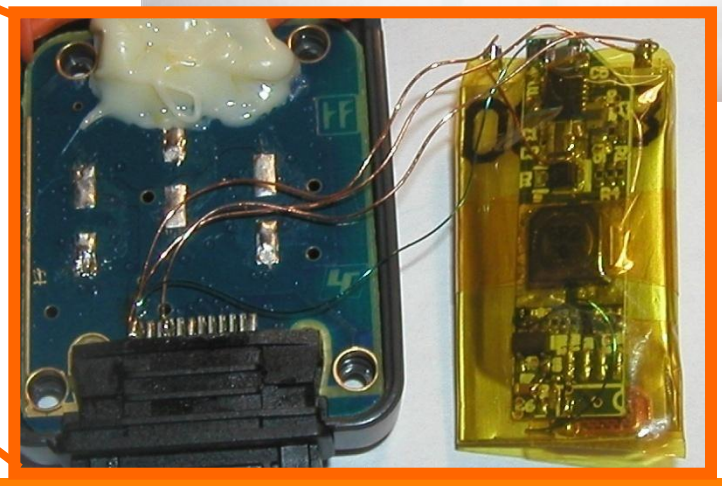
# Boost converter



# SEMC MPS-60 Modification

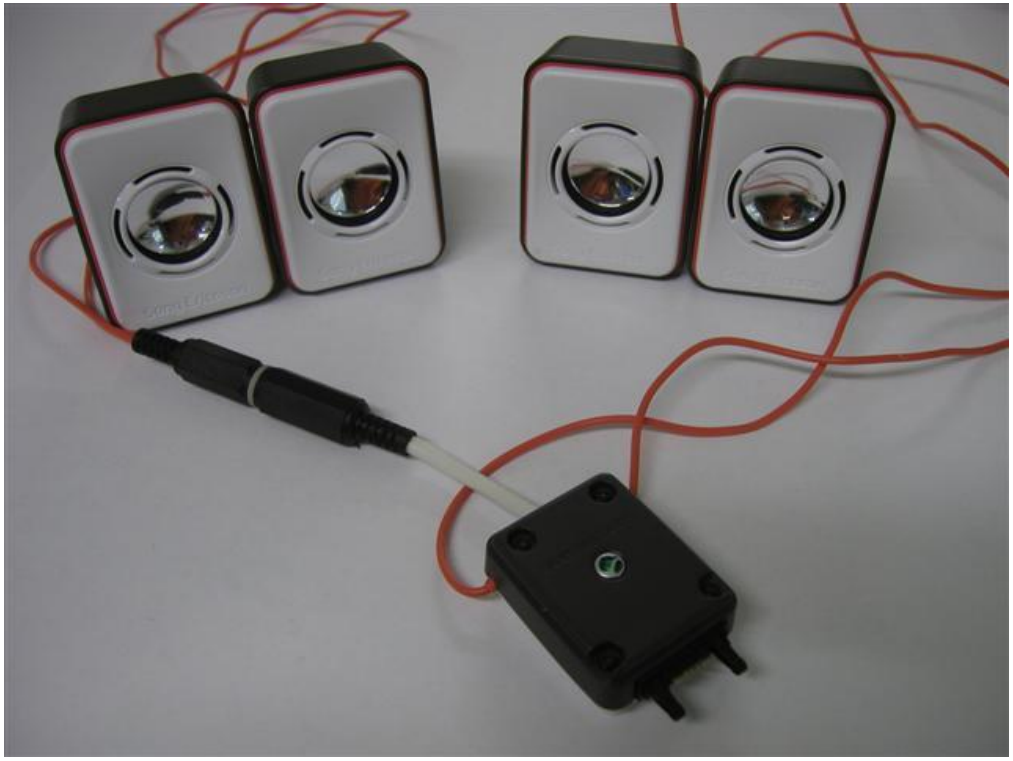
- Added a small boost converter & CAP-XX supercap to power the existing Class AB amplifier



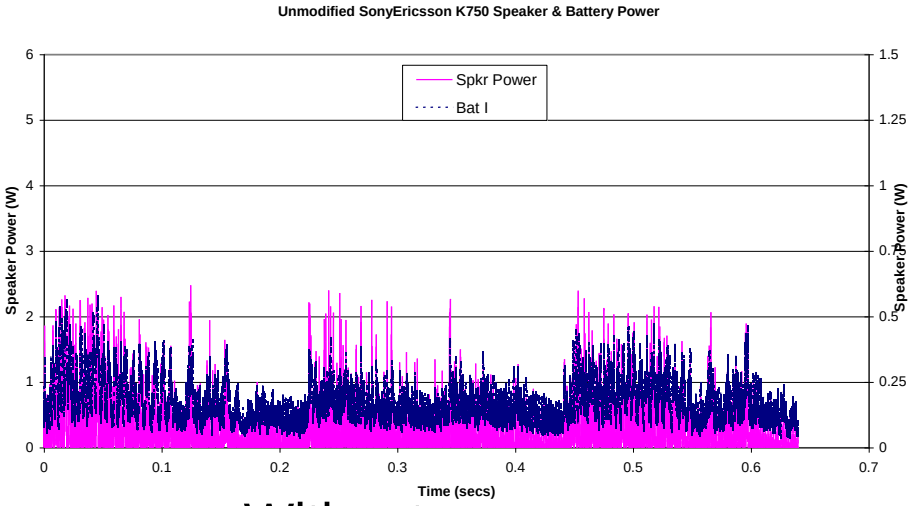
# SEMC MPS-60 Modification

- Used two sets of speakers in parallel to simulate 4W speakers

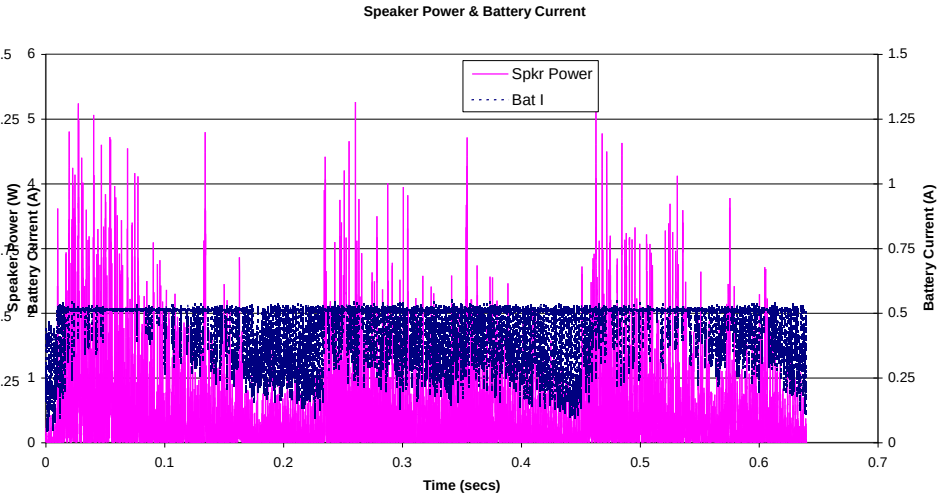


# Test Results

| SEMC MPS60 | Without Supercap | With Supercap | Change |
|---|---|---|---|
| Peak audio power | ~2W | ~5W | >100% |
| Peak battery current | 0.5A | 0.5A | Unchanged |
| RMS speaker power | 0.40W | 0.66W | 65% |




Without supercap

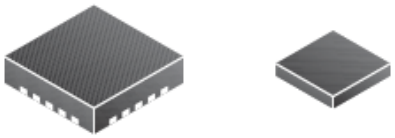



With supercap

# Solutions Available Now

- Fully integrated supercap drivers & combined boost converters/audio amplifiers are already available
- CAP-XX is at the centre of a thriving BriteSound™ ecosystem

TEXAS INSTRUMENTS
www.ti.com



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## 2.7-W CONSTANT OUTPUT POWER CLASS-D AUDIO AMPLIFIER WITH INTEGRATED BOOST CONVERTER

### FEATURES

- High Efficiency Integrated Boost Converter (Over 90% Efficiency)
- 2.2-W into an 8-Ω Load from a 3.6-V Supply
- 2.7-W into an 4-Ω Load from a 3.6-V Supply

### APPLICATIONS

- Cell Phones
- PDA
- GPS
- Portable Electronics

# Summary

- CAP-XX BriteSound™ dramatically improves the mobile audio experience & accessory audio performance (eg, USB speakers)
- CAP-XX BriteSound™ will also protect the playback experience from interference by power interruptions & voltage transients (eg, network poll in a mobile phone)
- CAP-XX supercapacitors enable more energy to be extracted from batteries, and more peak power to be delivered from current-limited host interfaces
- Resources:

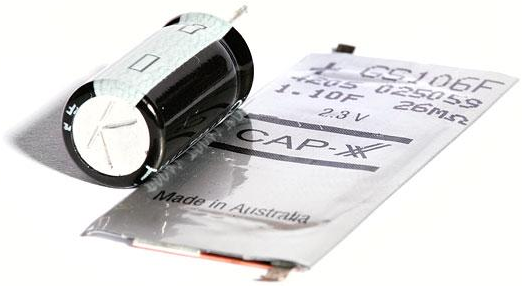
  http://www.cap-xx.com

  http://www.cap-xx.com/resources/resources.htm

  http://www.powermanagementdesignline.com/188100789

  http://www.audiodesignline.com/199901518

  http://www.audiodesignline.com/199904215




# CAP-XX

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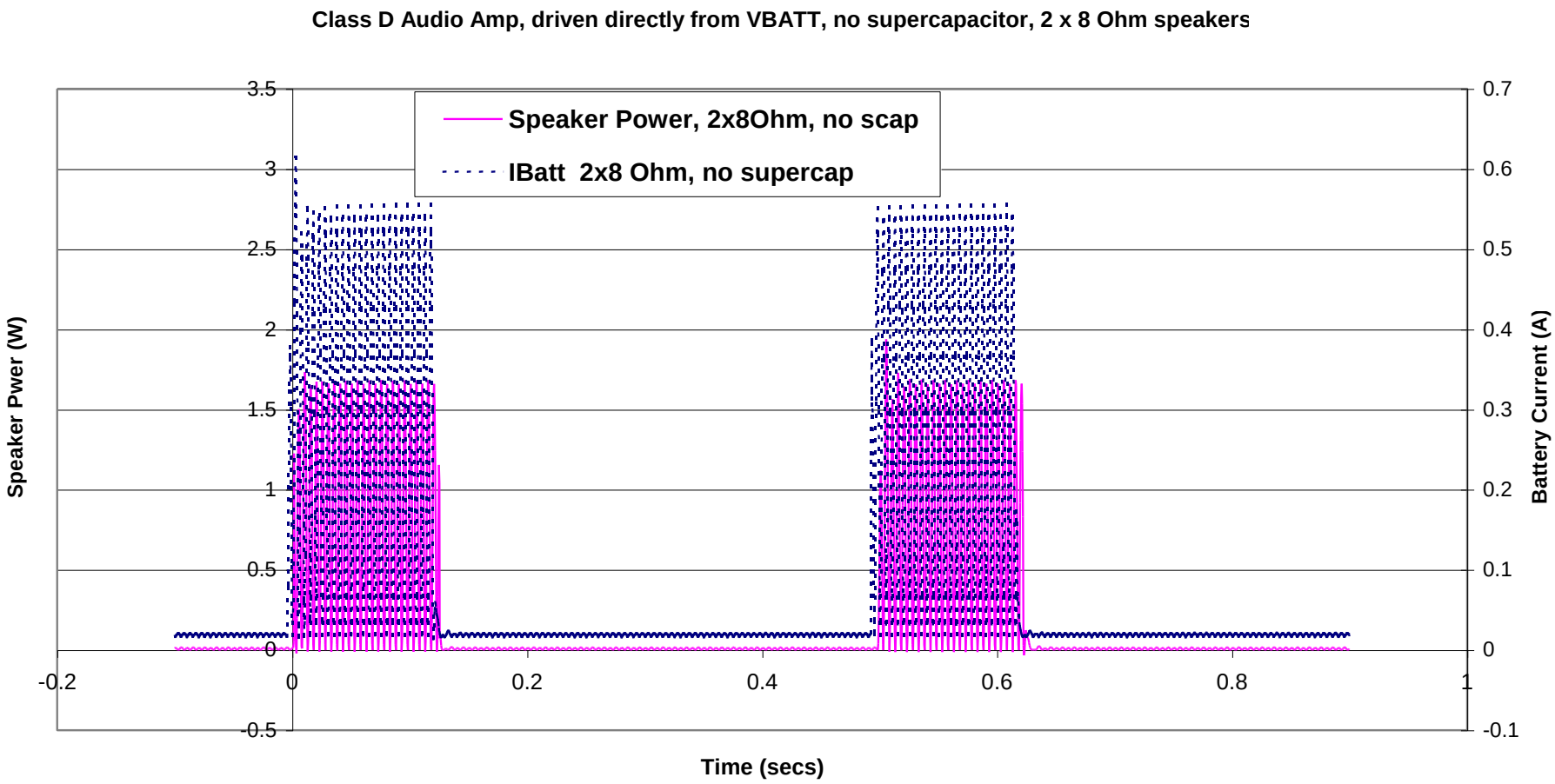
www.cap-xx.com

# Additional Material

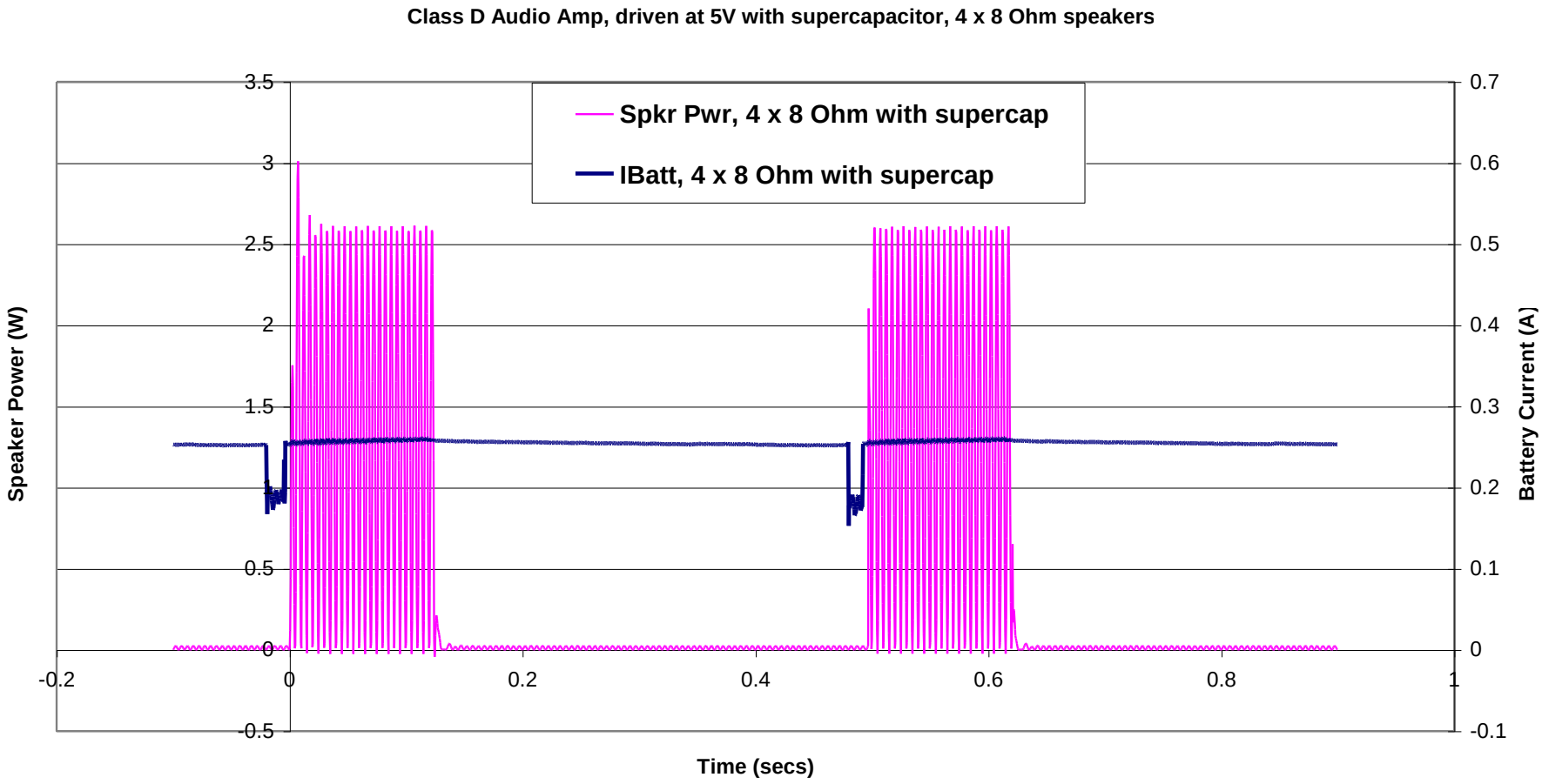
# Better Multimedia Performance

- A Li-Ion battery alone can drive a 5W audio amp for high fidelity sound, but…
  - 5W audio @ 5V requires the battery to supply ~1.8A (90% efficient boost, battery @ 3.5V, impedance = 200mΩ including connection)
  - Other high power functions may make concurrent demands (eg, mobile phone PA, TV, HDDs, etc.)
  - Current will be limited to the audio power amp to satisfy these loads
  - Voltage fluctuations in the audio amp's supply will be heard as noise
- The supercapacitor provides the excess current for audio, concurrent with other demands, and
- "Stiffens" the audio power supply to reduce noise and improve sound fidelity

# Synthetic base beat without supercapacitor

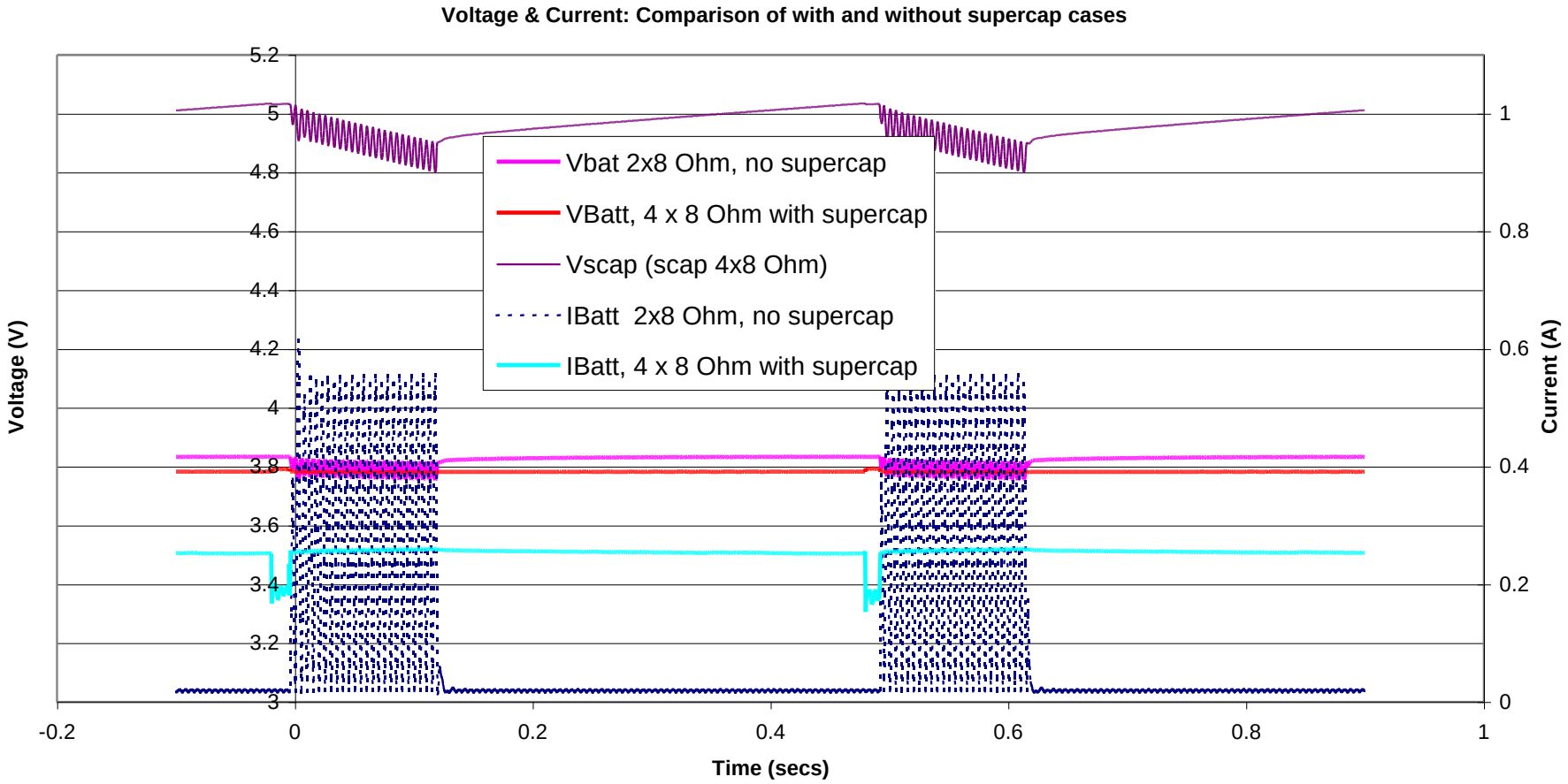


# Synthetic base beat with supercapacitor



# Base beat comparison

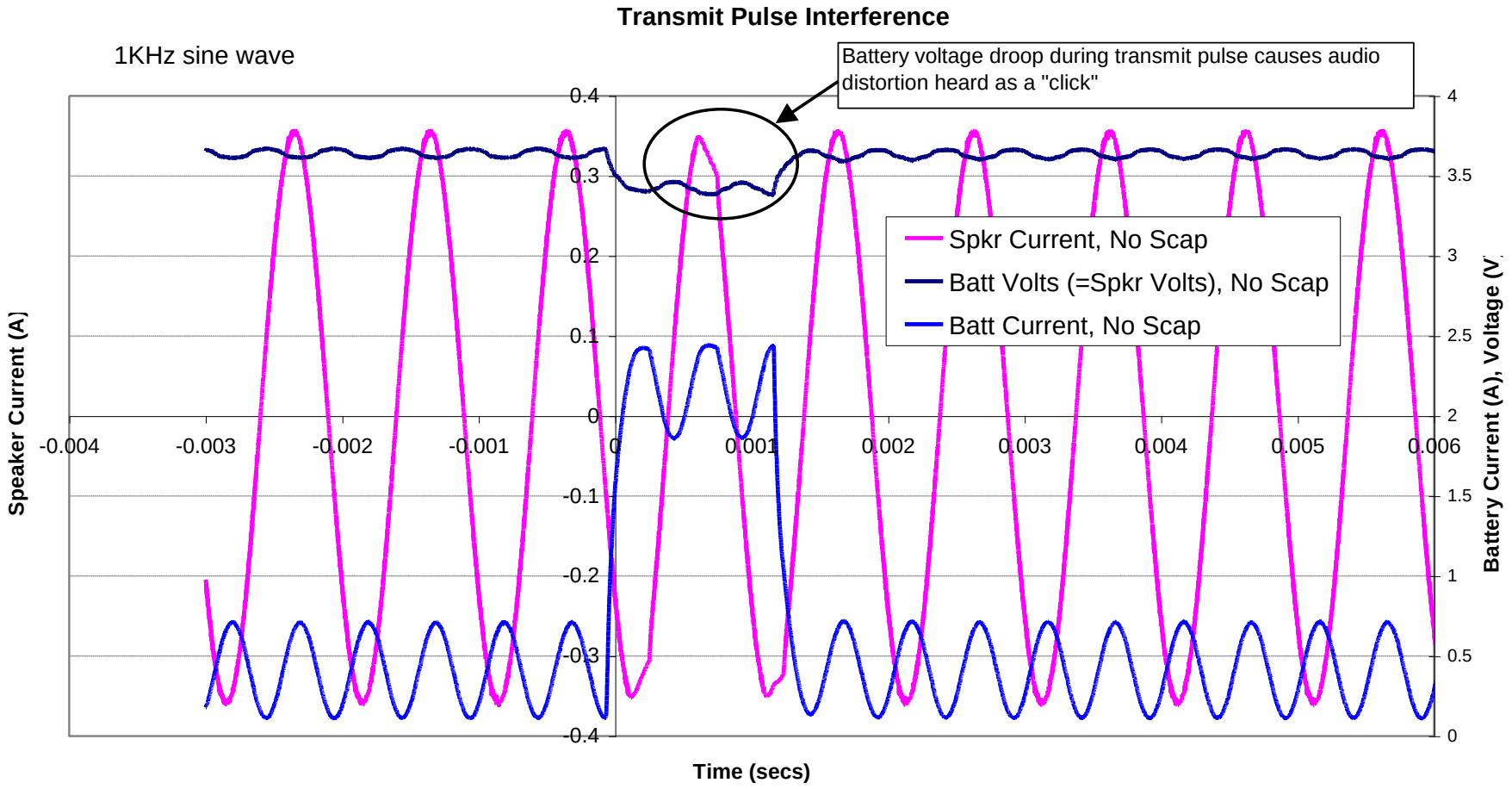


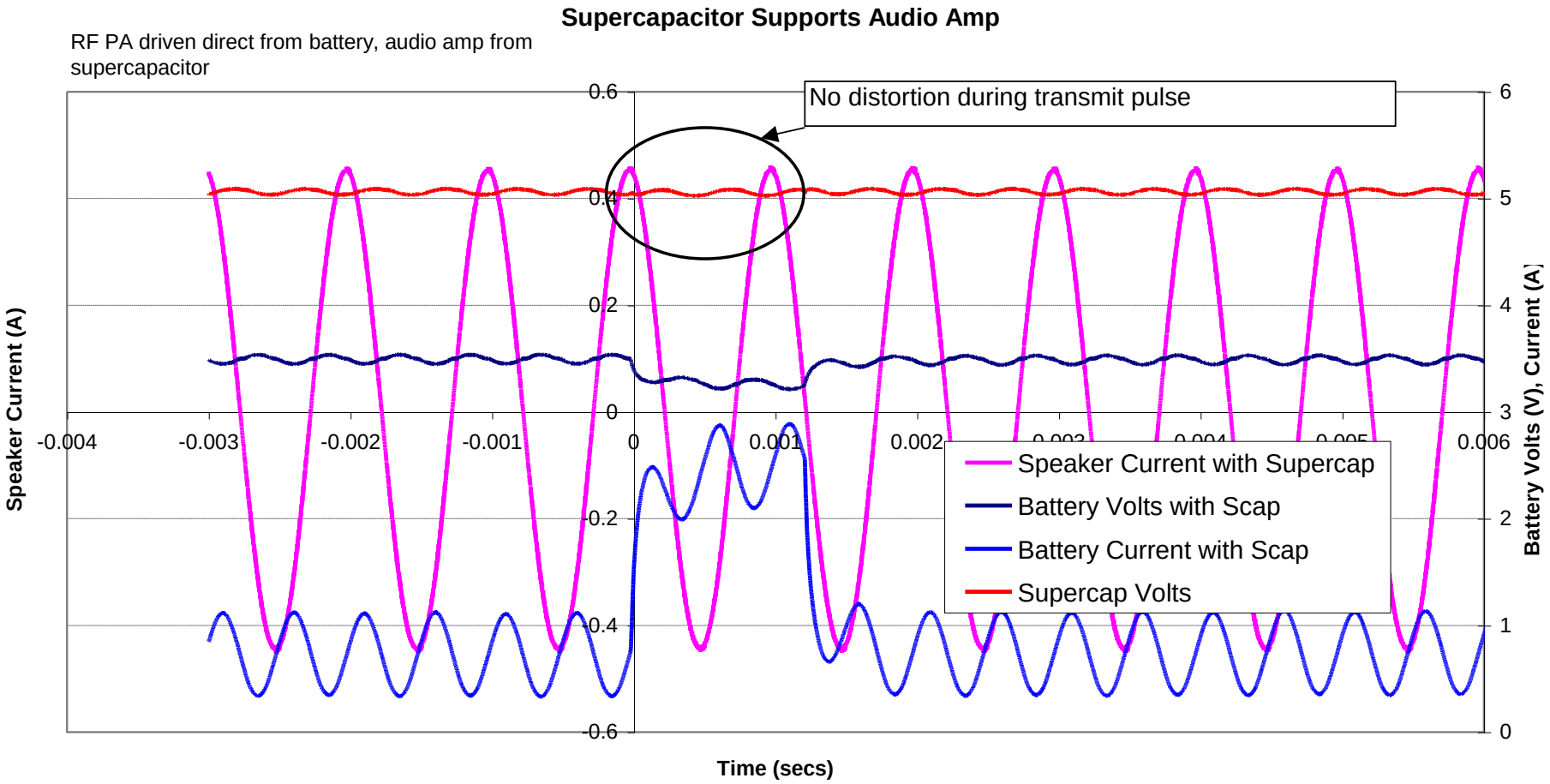
# Better Multimedia Performance

- Audio power increased
  - 1.7W peak with no supercapacitor
  - 2.6W peak with supercapacitor
  - 53% increase
- Peak battery current reduced
  - 550mA peak with no supercapacitor
  - 260mA with supercapacitor, current limit at input to boost converter
  - 53% reduction
- Battery voltage droop reduced
  - Min battery voltage increased from 3.75V to 3.79V
- Audio amp supply voltage increased
  - From Vbatt, ~3.6V to 4.8V

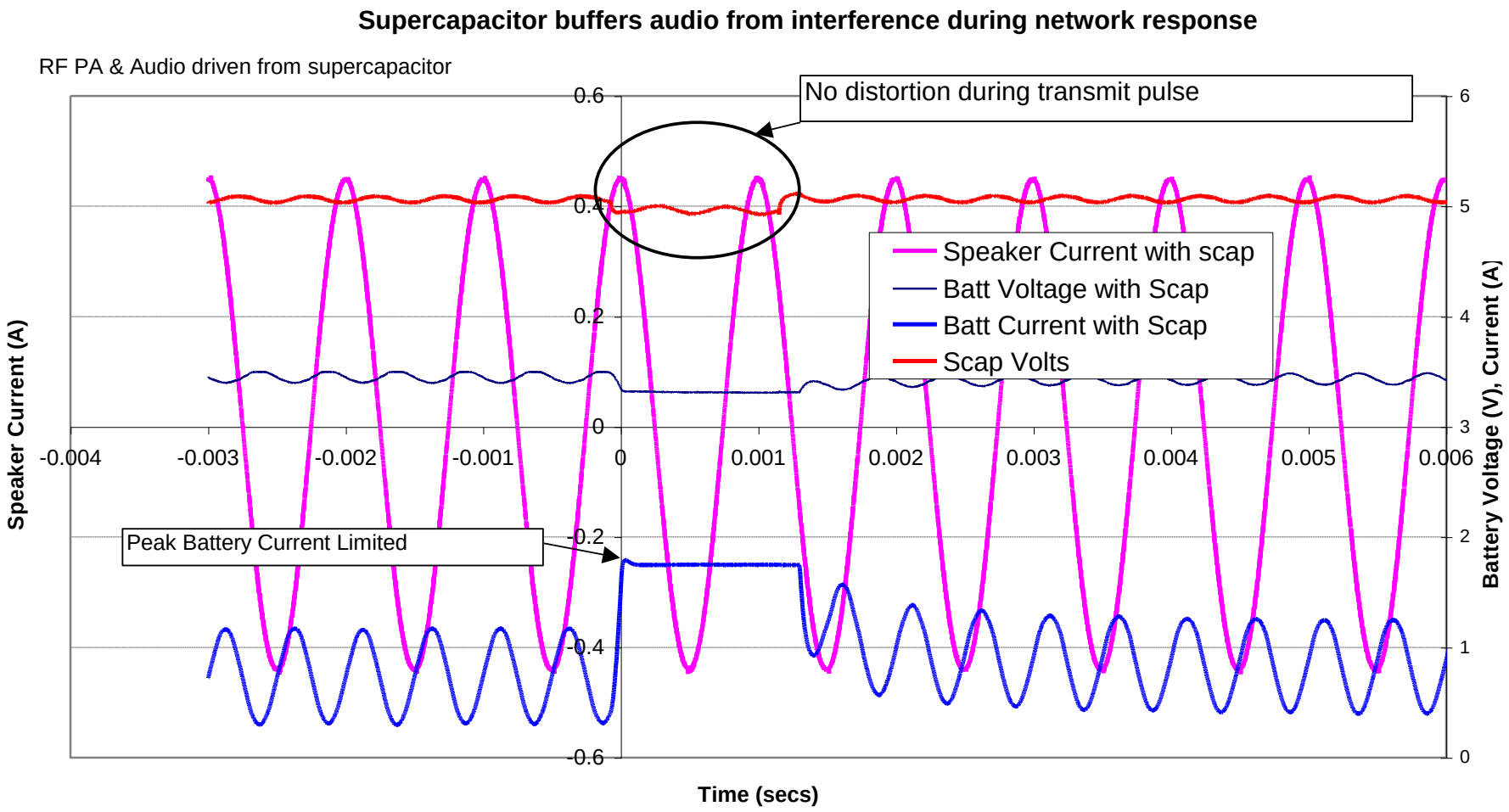
# Network poll causes interference



# Better Multimedia Performance



# Better Multimedia Performance

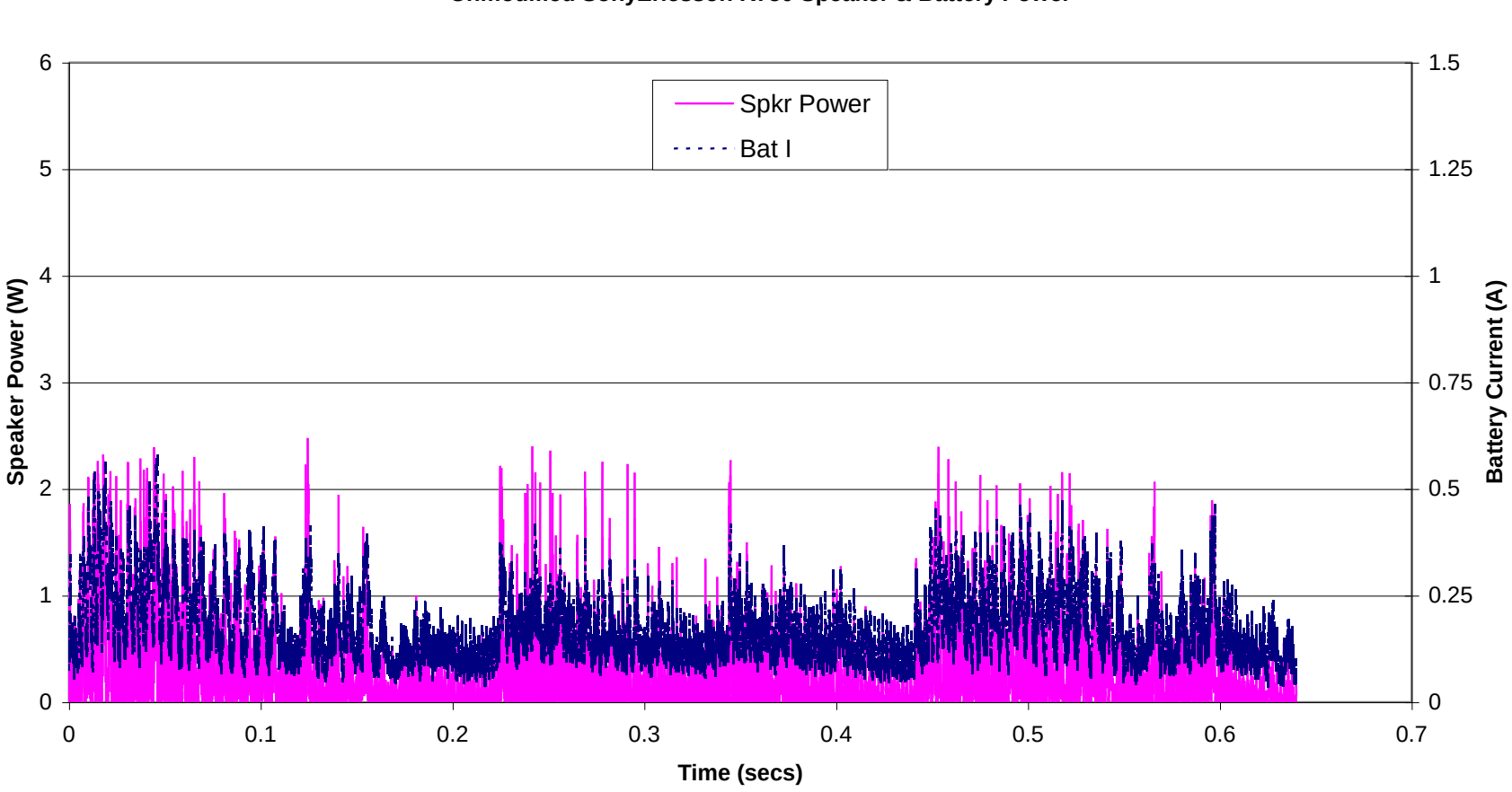


# Better Multimedia Performance

- No supercapacitor
  - Battery supplying audio amp & RF PA directly
  - If listening at close to full volume, battery voltage droop during response to a network poll will cause distortion heard as a “click”
  - Battery current > 2A
- Supercapacitor supports audio only
  - Battery supplies RF PA, supercapacitor supplies audio amp
  - Battery charges supercapacitor through input current limited boost
  - Supercapacitor voltage unaffected by RF transmission, no audio distortion
  - Battery current > 2A
- Supercapacitor supports audio & RF PA
  - Battery charges supercapacitor through current-limited boost
  - Supercapacitor can supply peak current to audio amp & RF PA simultaneously, no audio distortion
  - Battery current < 2A at all times (~1.5A)
  - Bonus: Supercap enables calls in very cold weather, -20 C operation

# Music Audio without Supercapacitor

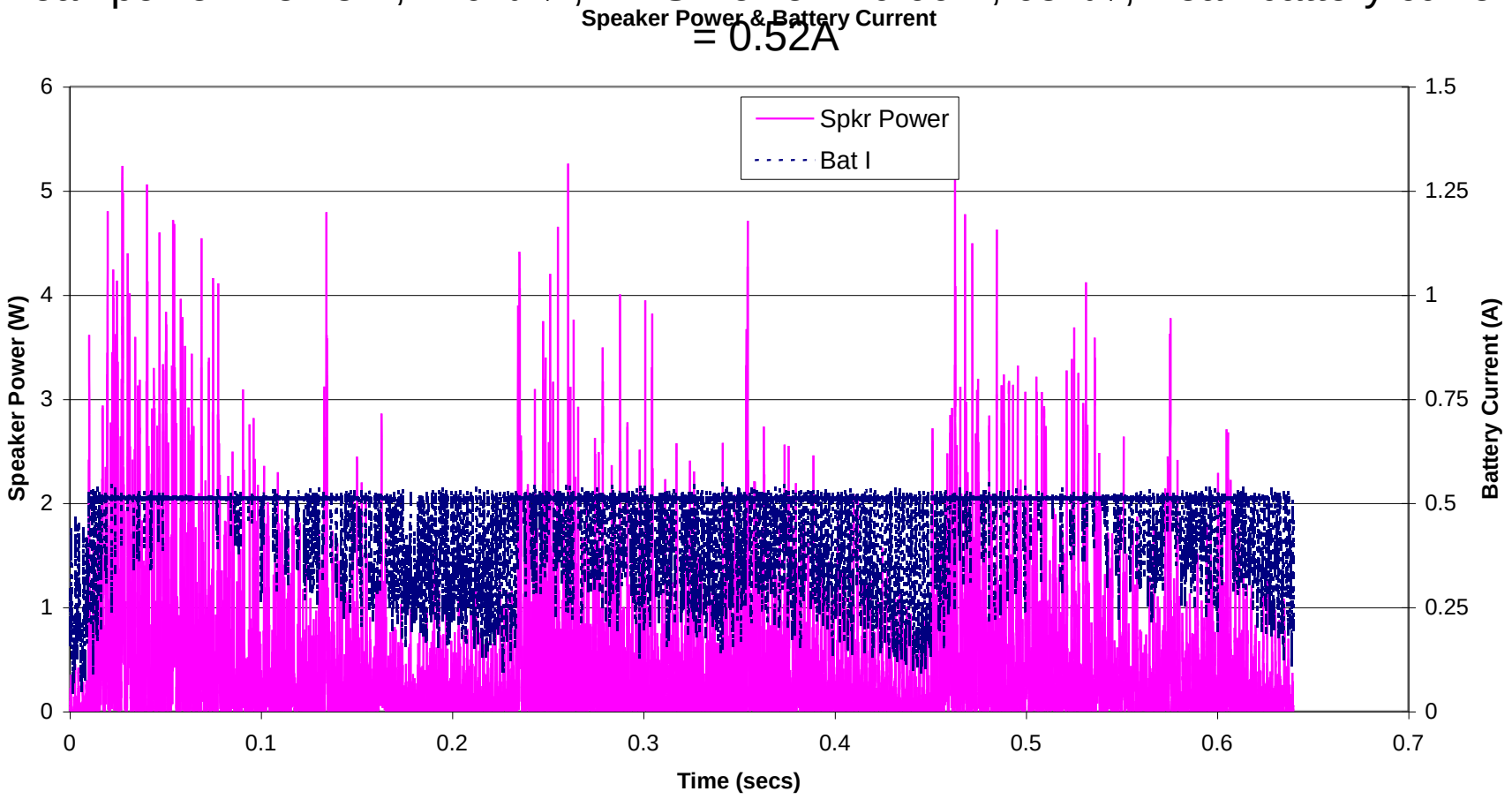
Peak power = 2.5W, RMS Power = 0.4W, Peak battery current = 0.57A



## Music Audio with Supercapacitor

Peak power = 5.25W, 110% ↑ ; RMS Power = 0.66W, 65%↑; Peak battery current = 0.52A

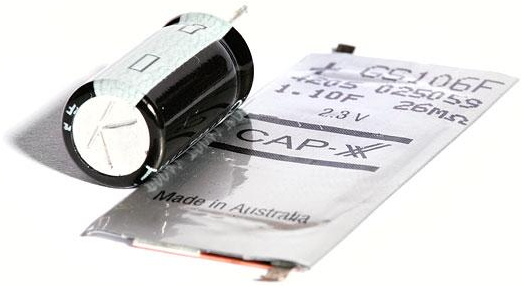


# Better Multimedia Performance

In Summary:

- Peak Audio Power increased
  - From ~2W to ~5W, >100% increase
- Peak Battery Power stays at ~0.5A
  - Current limited in supercapacitor case
- RMS speaker power increased
  - From 0.40W to 0.66W, 65% increase

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