

Precise Power Characterization of Modern Android Devices

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<http://moroso.emarhakil.com/~joshua/743wiki/>

In brief...

- Android power management is terrible
 - HTC EVO 4G: 18 hours of battery
 - *if I'm lucky!*
- Processes are getting smaller
 - Leakage currents are getting bigger
- *Precise* power measurements are necessary to optimize!

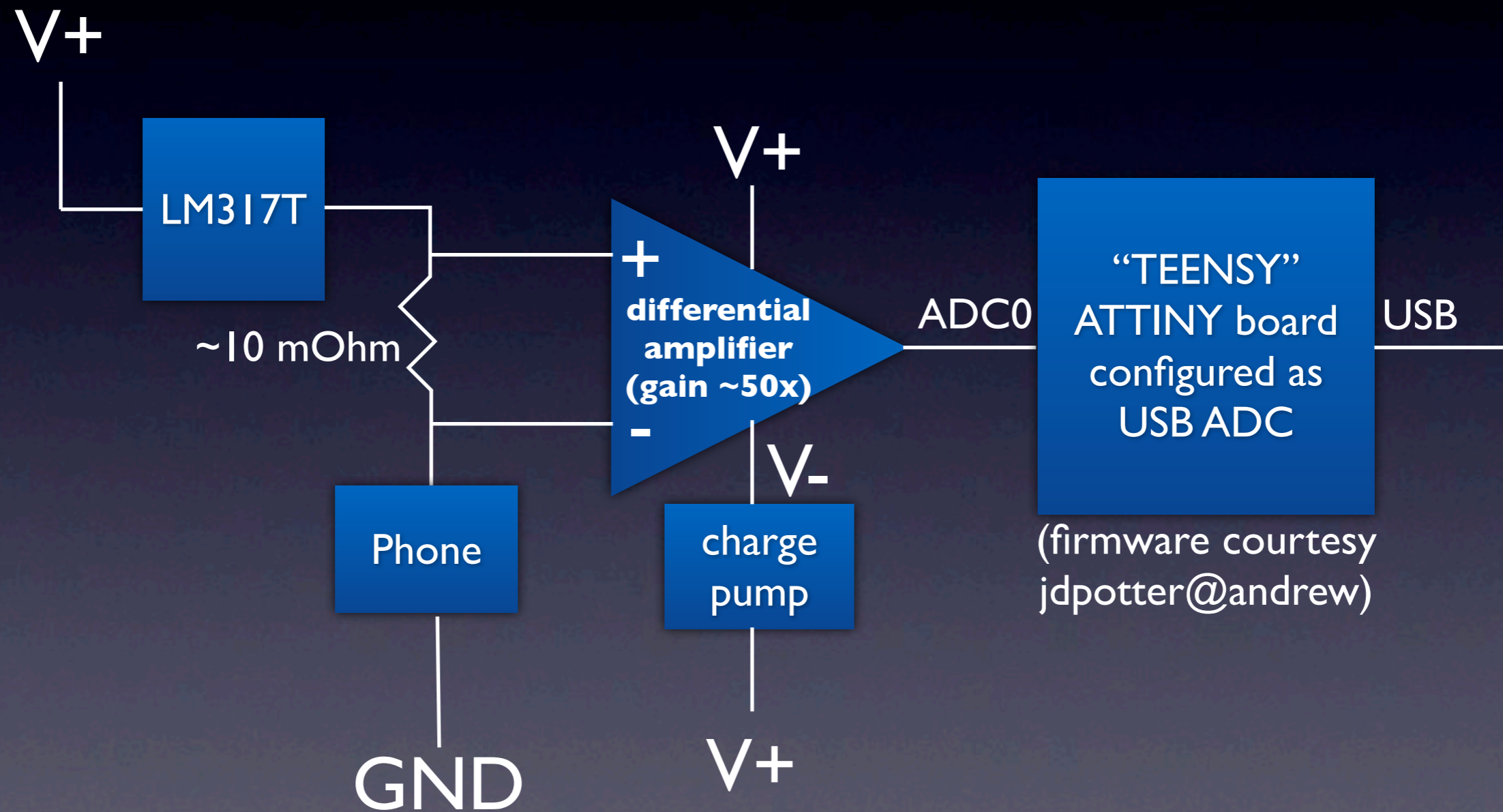
Overview

- *Motivation*
- *Overview*
- Hardware
- Software test plan
- Current results

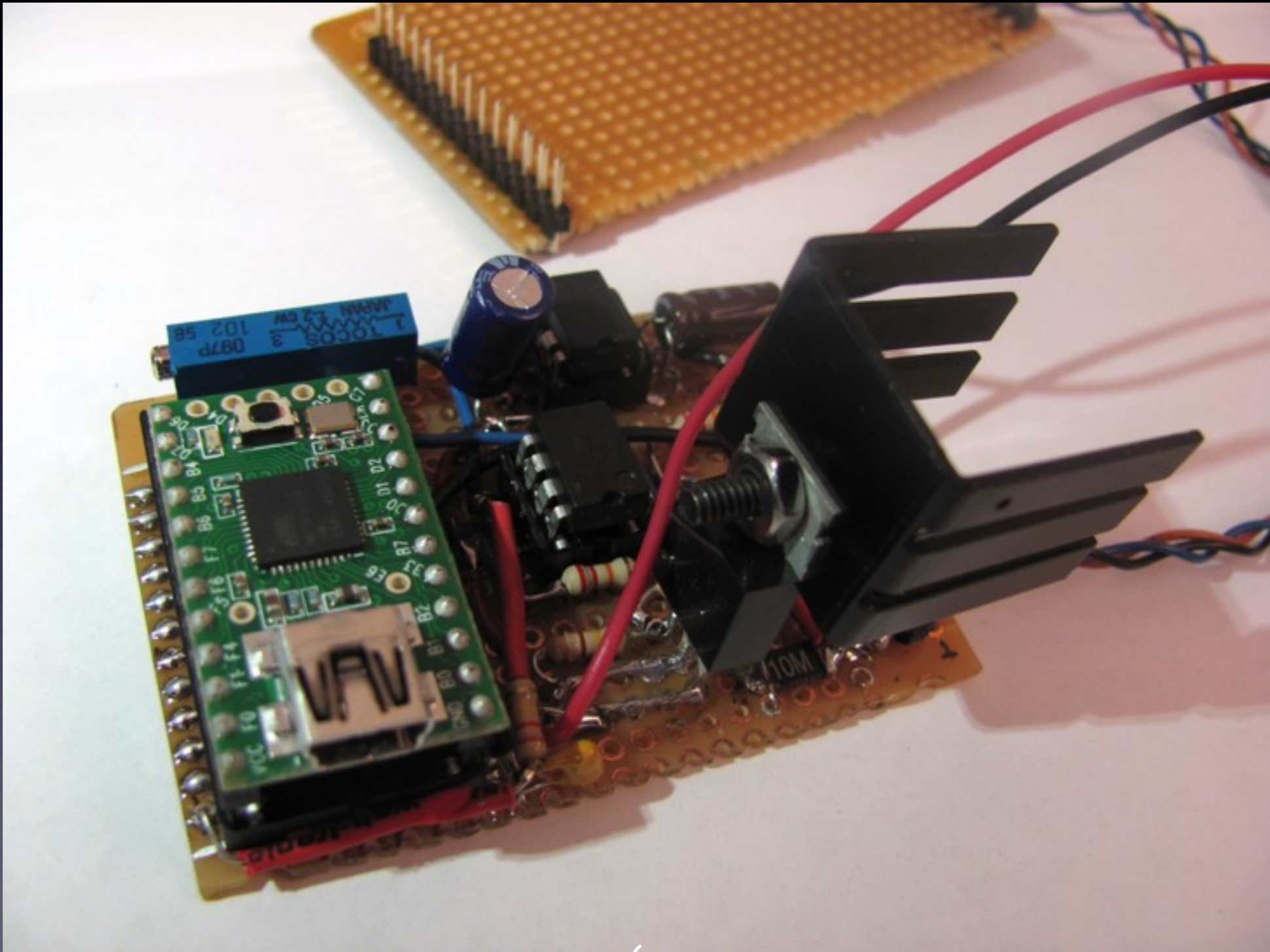
Hardware

- First stage hardware *built!*
 - Simple current-measuring apparatus
- Fits in place of battery
- Measures voltage across small sense resistor, reports back to host PC
- Voltage regulated to keep power proportional to current

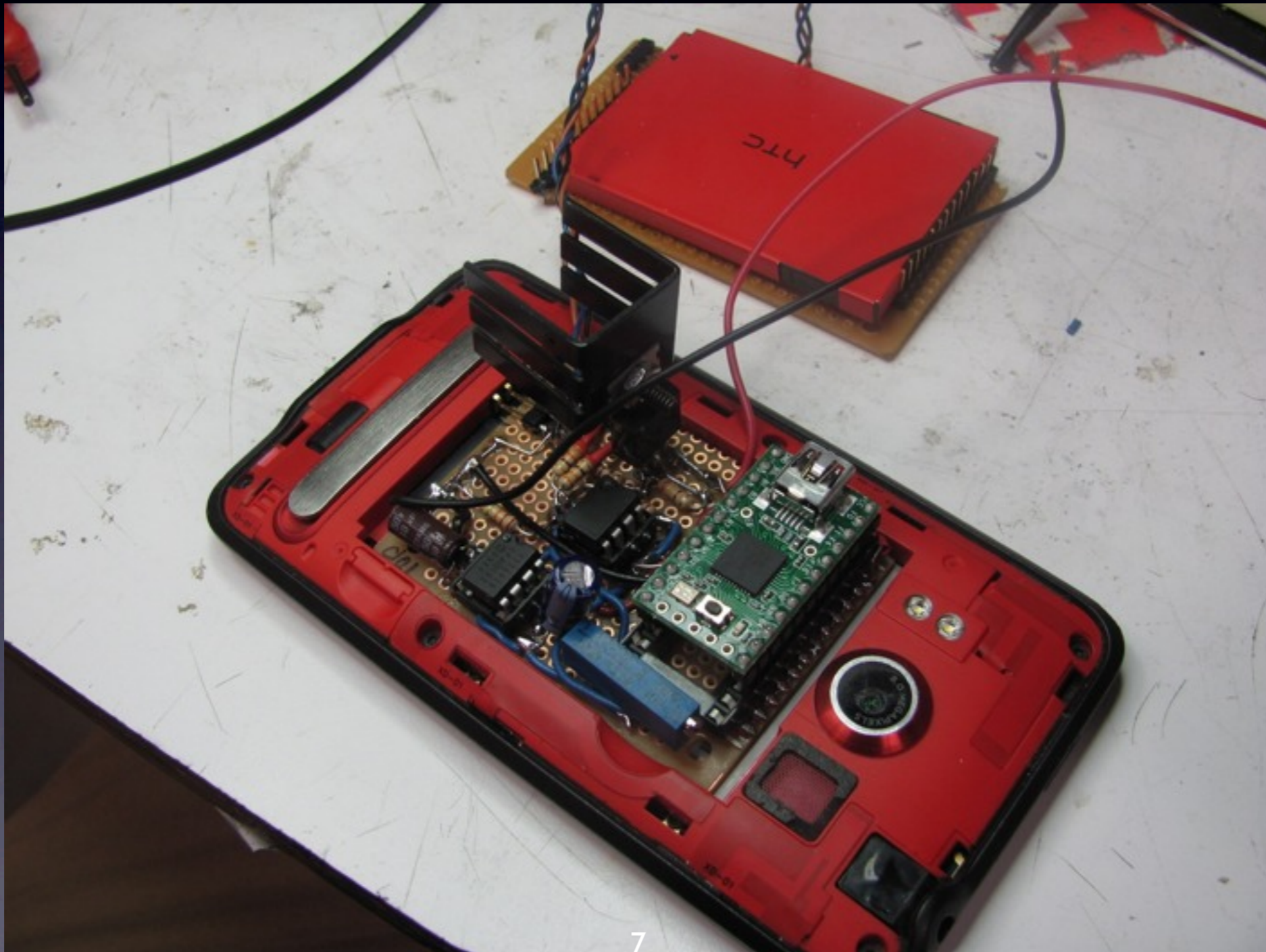
Hardware block diagram



Hardware: completed



The module loads perfectly
into the running kernel



Testing Plan

- Baseline:
 - CPU *on*, but set to 240MHz
 - All communication radios off
 - Backlights turned off (LCD, buttons)
 - LEDs turned off (system, flash)

Testing Plan

- Radios: (3G, 4G, Bluetooth, WiFi)
 - Off
 - On, and searching for signal?
 - On, and idle
 - Various data rates up to full radio utilization
- Display Backlight
 - Off
 - Various brightness levels

Testing Plan

- CPU
 - Floating point unit under full utilization
 - Integer ALU under full utilization
 - Memory bandwidth under full utilization
 - CPU wake ups per second from sleep

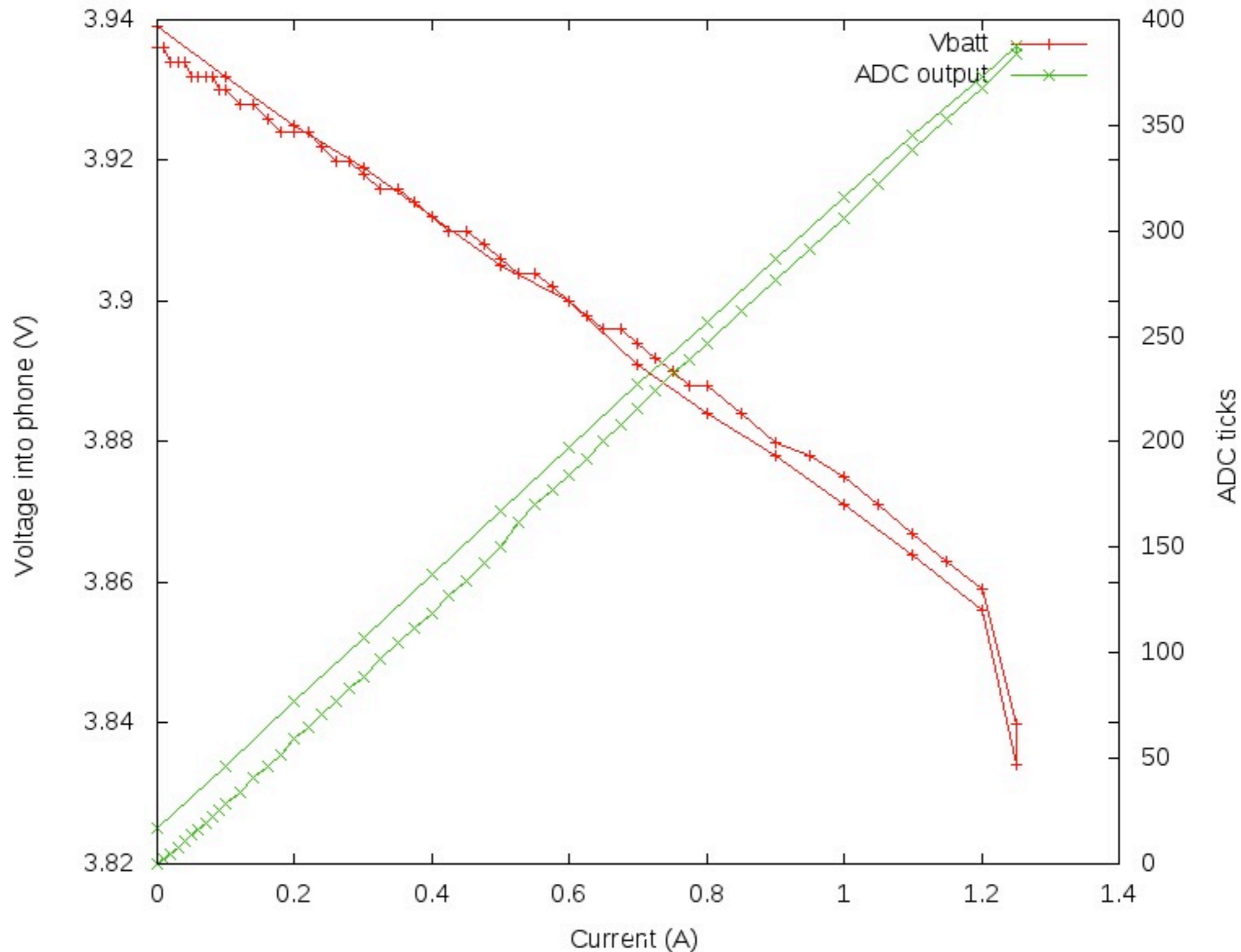
Testing Plan

- Miscellaneous
 - LED flash/flashlight at various brightness levels
 - Touchscreen?
 - Various other LEDs (button backlight; charge LED; ...)

Preliminary results

- Hardware
 - works!
 - Linearity overall good
- Some glitches
 - Reading goes insane when CDMA/3G radio transmitting
 - Strange temperature coefficients

Hardware linearity



Preliminary results

- Phone seen to draw around 110mA with screen off, CPU max idle, ...
- Interesting results:
 - System draws *only 10mA more* idling at 1Ghz (even with voltage increased) vs. 240MHz!
 - LED flash at full brightness draws 860mA (!!!)

Questions?

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