ARA4-7 Status/Plans

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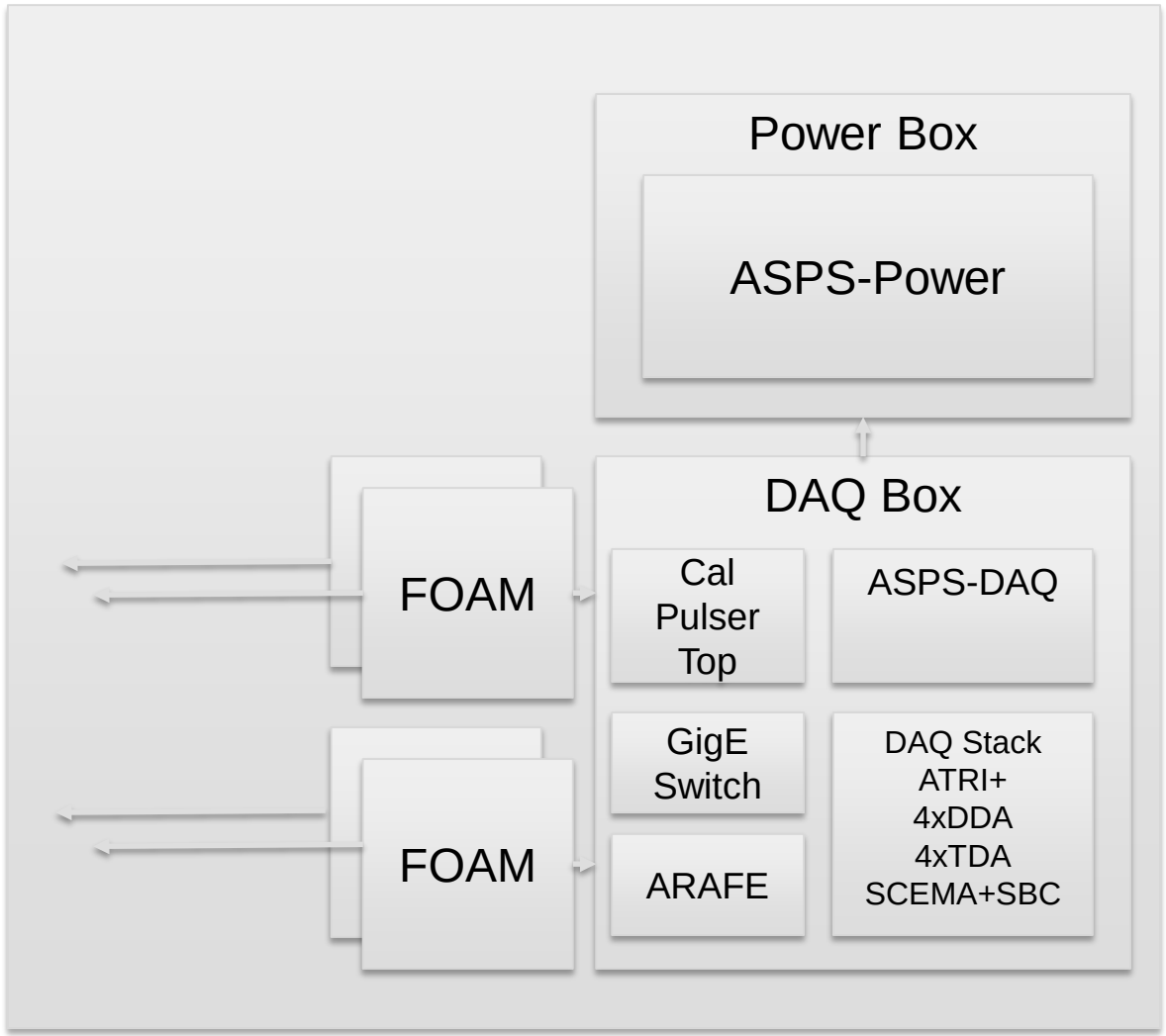
ARA Collaboration Meeting, 7/23/15

ARA4-7 Design Overview



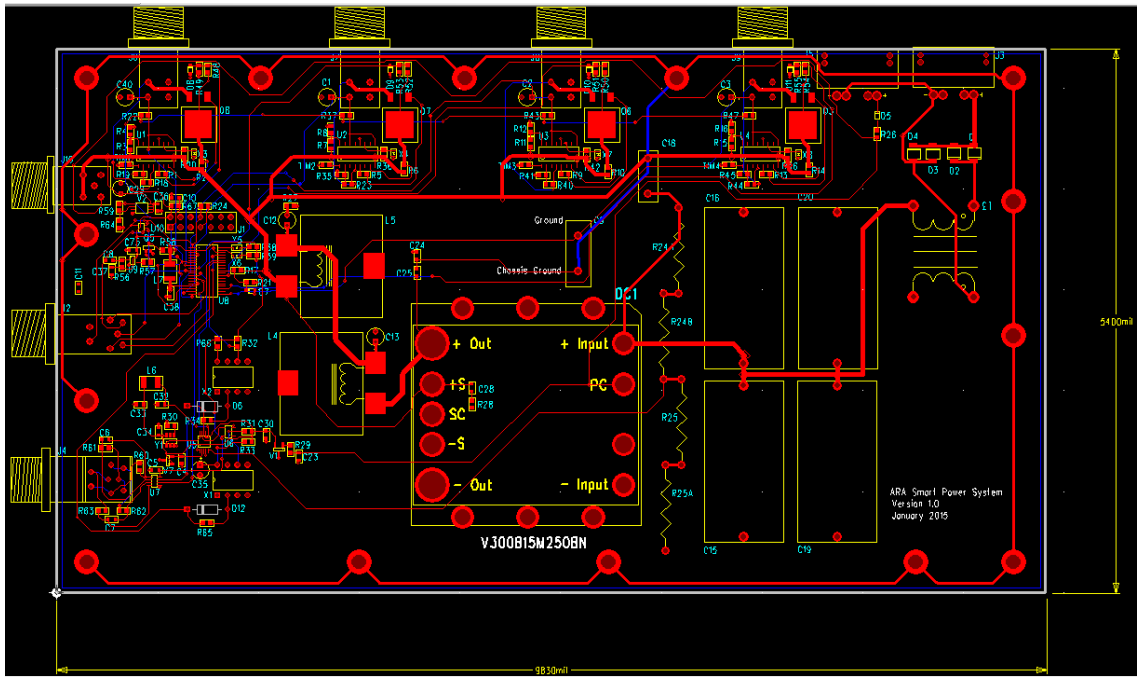
- Downhole doesn't really change
  - Minor changes (OSU bias-tee in DTM, minor LNA changes, etc.)
- FOAM changes slightly
  - Power pulled from DAQ box via bias-tee
  - Saves cabling, eliminates loop
- Power box redone completely
  - Part of ARA Smart Power System
- DAQ box also changed
  - Power fanout-> ASPS-DAQ
  - Cal pulsers moved in
  - Fiber transceiver -> GigE switch
  - ARAFE setup
- DAQ Stack *can* (and *should*) change
  - (but doesn't *have* to change)

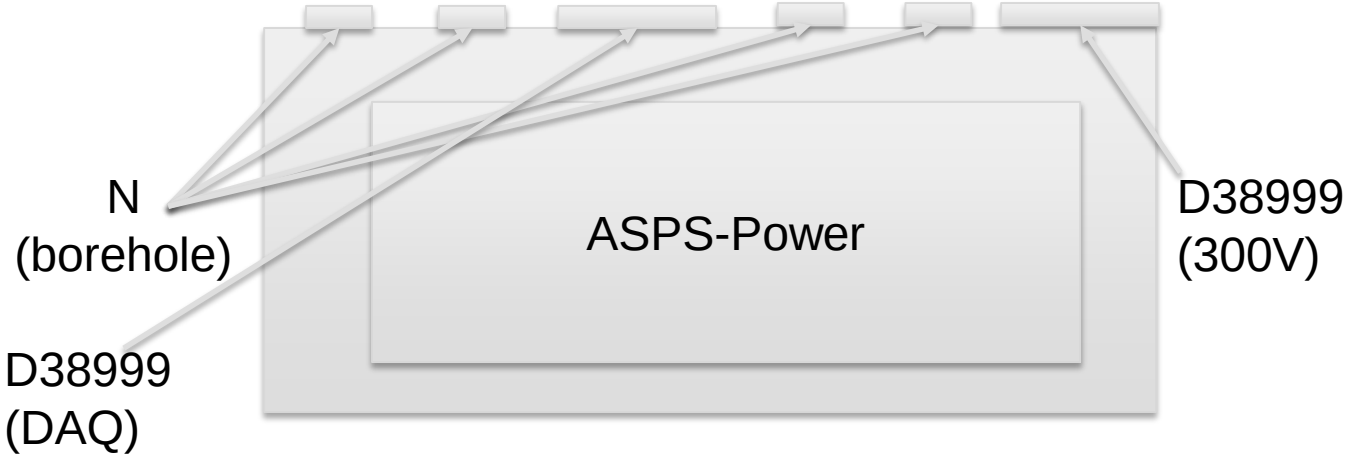
ARA Smart Power System Overview

- ARA1-3 power system problems
  - Multiple supplies (expensive/awkward wiring)
  - No monitoring
  - No control
  - Very large size
- ASPS-Power Design Goals
  - Simplify main conversion: Single +15V DC/DC converter
  - Monitoring/control in main power box
  - Microcontroller provides monitoring: add downhole load switches (+overcurrent/overvoltage protection for downhole)
  - Load switches soft-start downhole devices: no hard transients
- ASPS-DAQ Design Goals
  - Power control/fanout in DAQ box
  - Microcontroller for monitoring/control
  - Ethernet interface for independent system monitoring/control
  - Thermal control for -55 starts

ASPS-Power Status

- First prototype built (by Maryland)
- Currently testing at OSU
  - Second revision needed
- Box layout probably needs revision as well

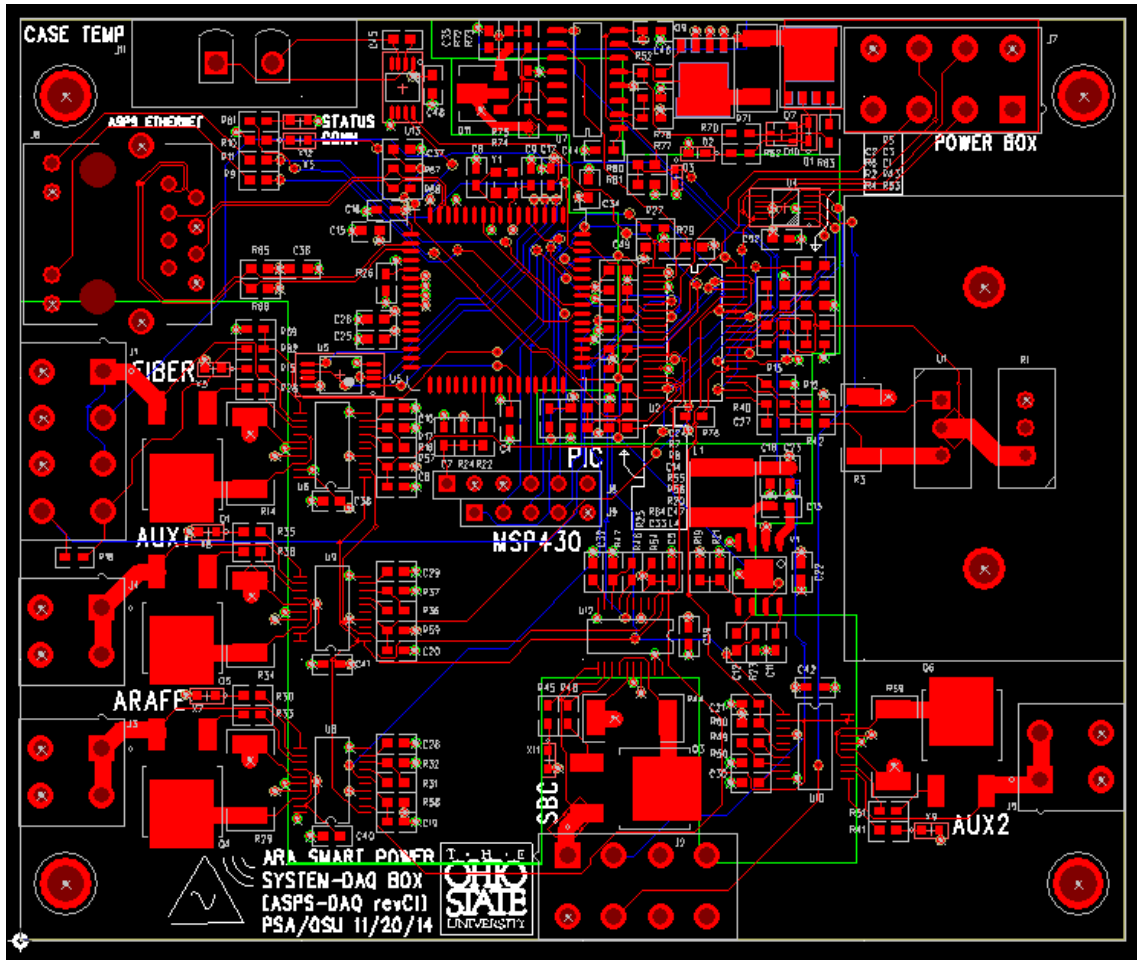




Current box layout: 4x N-type, 2x D38999

ASPS-DAQ status

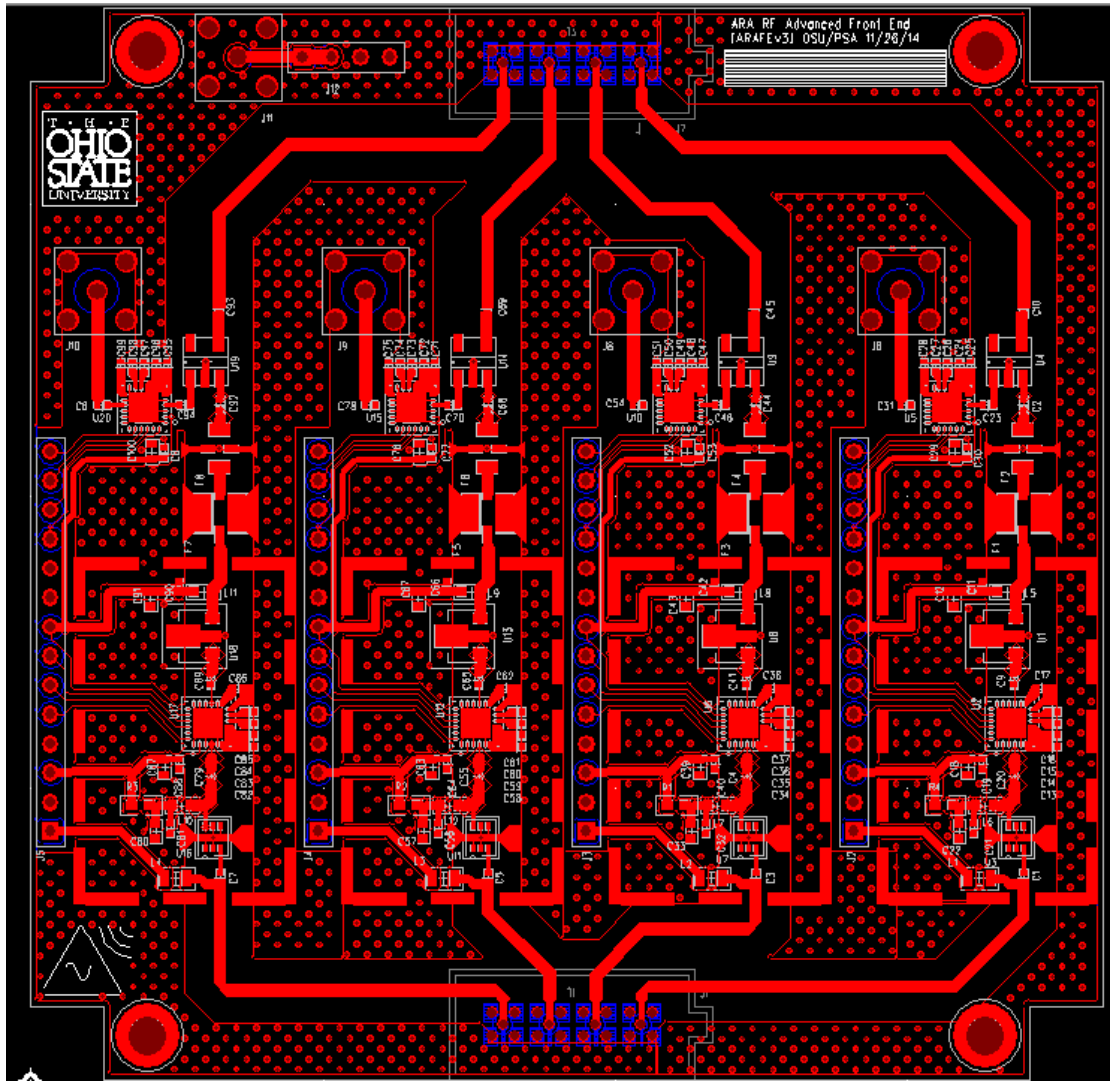
- Designed to fit into old ‘breakout’ board space
- First revision tested
  - Second revision ready
  - Need to send out
- “Non-smart” functionality all works
- Smarts can be added later (*including after deployment*)

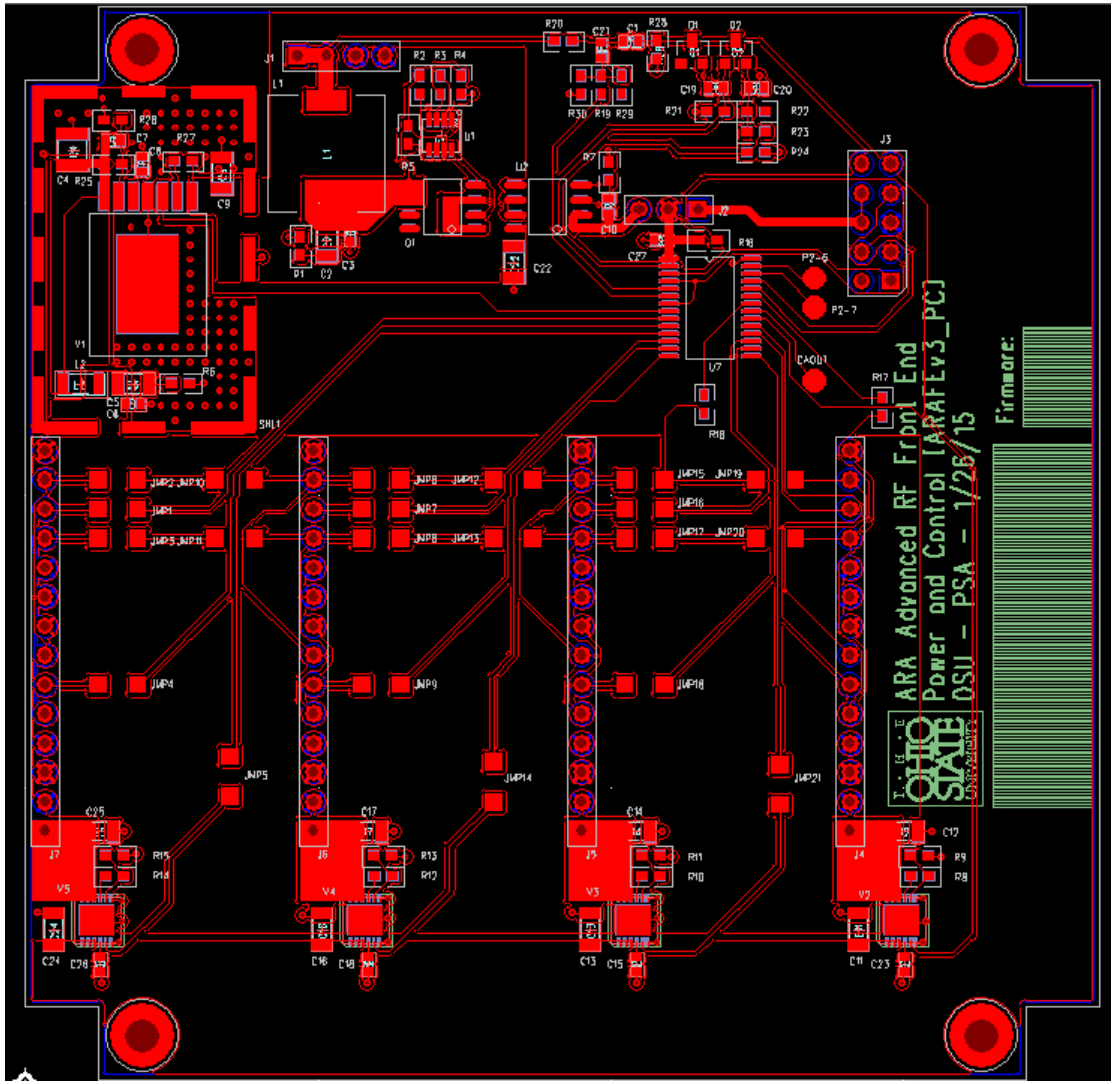


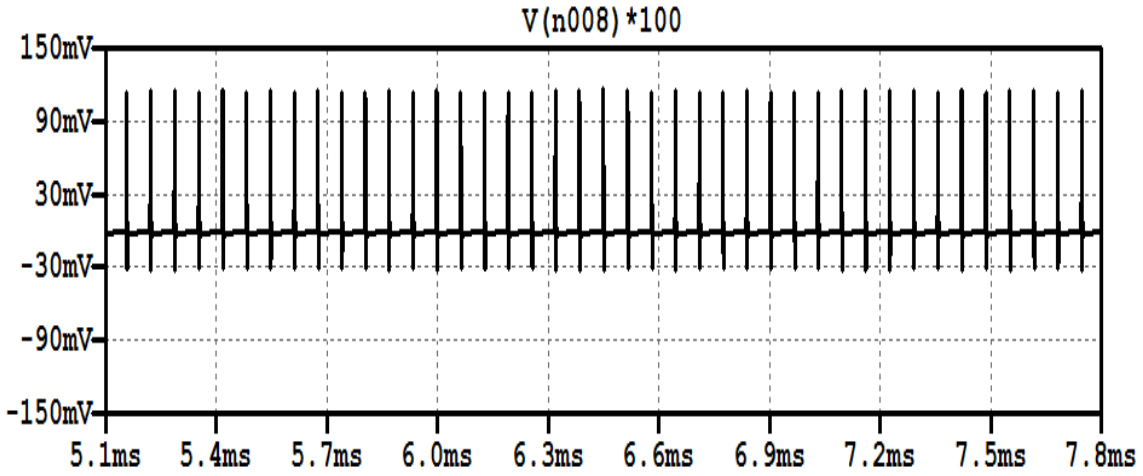
ARAFE Status

- Consists of 2 parts:
  - Power/control distribution
  - 4x ARAFE quads
  - Quads are 4-channel RF front ends integrated into Compac ‘blank’ box (low cost)
- ARAFE quads have 2 parts
  - RF board (30 dB gain, split,
  - Power/control
  - Power provided from distribution board via SMA/coax
- Physical design was a problem for a bit
  - Compac doesn’t provide ‘proper’ interior dimensions: pushed too close to margins at first
- Power/control has been trickier than expected
  - 12V->5V switch was unusably noisy, even with filtering
  - This was just a bad supply choice: a bit of research identified what we should have done
  - As an aside simulating DC/DC switching supply turn on transients *sucks*

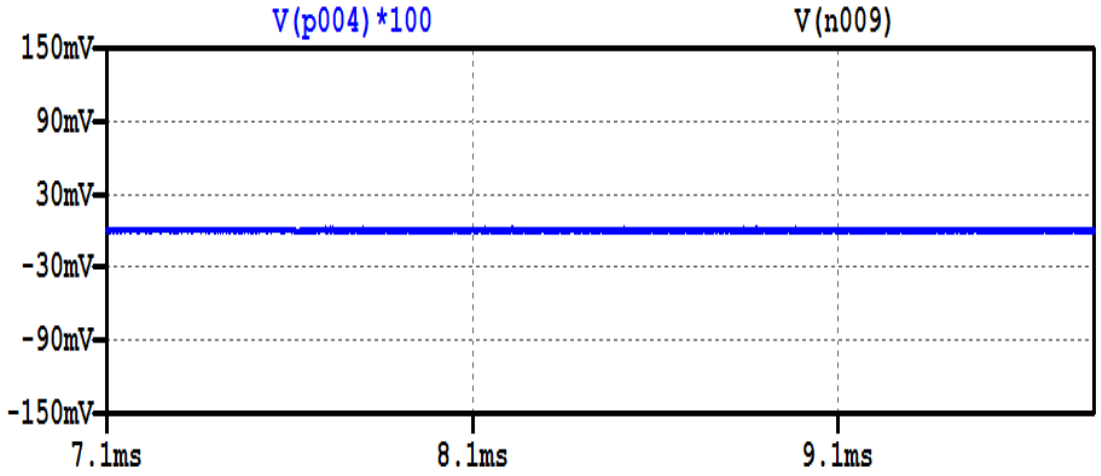
ARAFE boards (last rev)







Switching supply (LMZ12001) residue at input of amp, scaled by amp gain



Switching supply (LT8611) residue at input of amp, scaled by amp gain

ARAFE Status, cont.

- Also had issues with bias-tee powering
  - Previously were using an LDO with ‘enable’ to control downstream loads (OZ RX in FOAM)
  - No inrush control -> big voltage transients at amplifier input (>5V, amp goes boom)
  - Luckily we saw these in simulation first
  - Change to single 12V supply + load switch with slew rate control (soft-start)
- Revision with these changes is nearly ready, needs to get sent out

DAQ Stack status

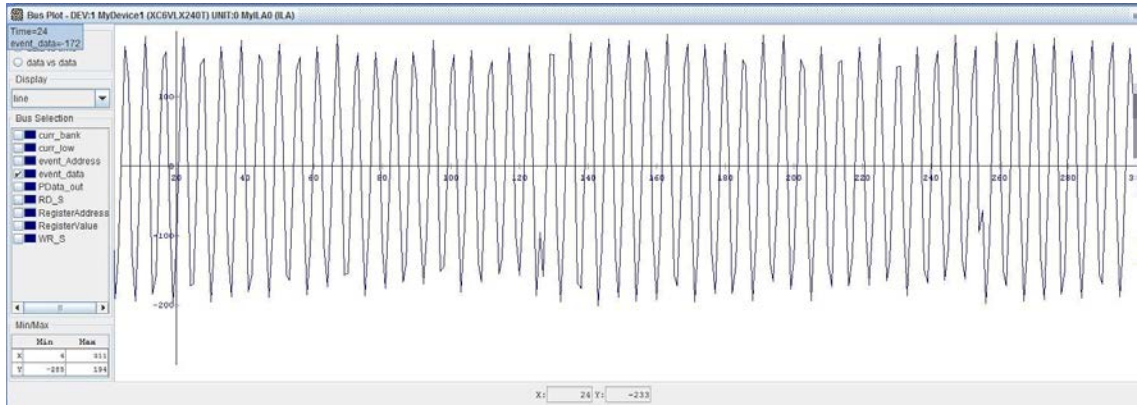
- Using existing TDA/DDAs, have 2x stations worth possible, but not assembled yet
  - (daughterboard pilfering for mini-ATRIs, etc.)
  - Need to reassemble soon
- *Still very hopeful* for a LAB4-based DDA
- Possibly improved TDA as well?
  - (TDAs are easy)

Digitizer info/status

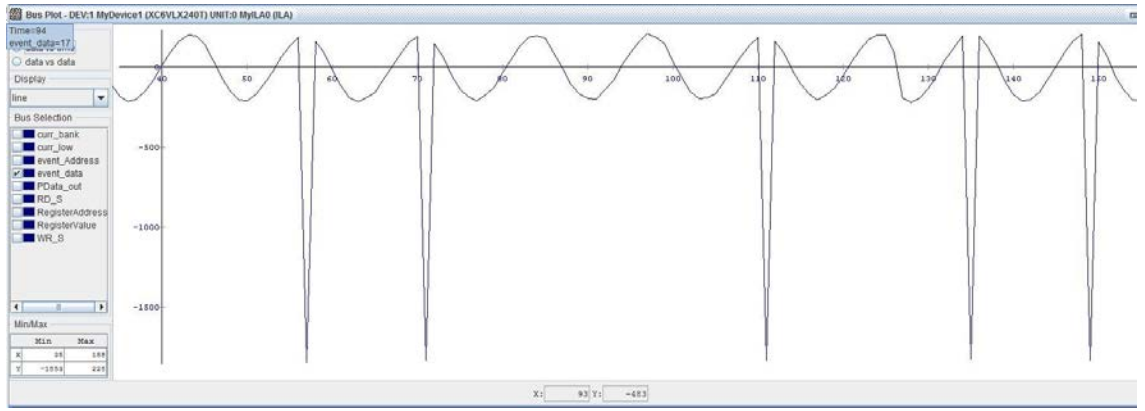
- Existing ARA stations use IRS2
  - We really don't want to do this again ("the IRS2 is a dog" to quote Kael) but we *can* if we have to
  - IRS2: 8 ch, ~2 GSa/s, 32k sample depth/ch, no simul. read/write, nonlinear transfer function, poor timing, but proven-ish
  - LAB4: 1 ch, 4 GSa/s, 4k sample depth, simul. read/write, linear transfer function, better timing, but unproven-ish
- LAB4 work is ramping up at OSU/UH for ANITA
  - This isn't a "blind start" – the LAB4 had strong progress last year
  - Focus is mainly on parameter tuning/control

LAB4 digitization examples

Note: absolutely no calibration here at all!



514 MHz sine wave digitized by LAB4
Periodic artifacts every 128 due to overall delay tuning (similar to Jonathan's block-to-block fit)



214 MHz sine wave digitized by LAB4
"spike" observed near top of waveform is Wilkinson tuning

Conclusions

- New hardware (ASPS/ARAFE) coming, but still needs work
  - Have people at OSU helping with ARAFE (future…?) but more help would be very+++ appreciated (simulation, test boards, etc.)
  - ASPS-DAQ is an issue, although smarts is a “later” possibility (even after deployment)