How the Other Half Lives

Developing SDR Software for the Macintosh Platform

Jeremy C. McDermond, J.D. (NH6Z)

About the Author

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- Licensed in 1986 at age 14 as KB7AKH
- Began to program on the Apple II at age 5
- Learned C in 6th grade (on a 512k Mac)
- Spent 15 years in systems and network engineering
- Numerous industry certifications such as MCSE, Sun, and IBM AIX
- Avoids MS Windows like the plague

The OpenHPSDR Platform

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- Direct Downconversion Receiver (Mercury)

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- Direct Downconversion Receiver (Mercury)
- Direct Upconversion Transmitter (Penelope)

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- Direct Downconversion Receiver (Mercury)
- Direct Upconversion Transmitter (Penelope)
- USB 2.0 Connected
  - Future connection via gigabit ethernet

Mercury


ALTERA
Cyclone III
EP3C25Q240C8N
J AADA00825A
MERCURY DDC Rt Rev A12
http://hpsr.org
http://tapr.org/DHL
http://amsat.org
A3
007 R
A 6921 58

Mercury

- LTC2208 ADC as close to antenna as possible
  - 130Msps 16-bit

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  - 130Msps 16-bit
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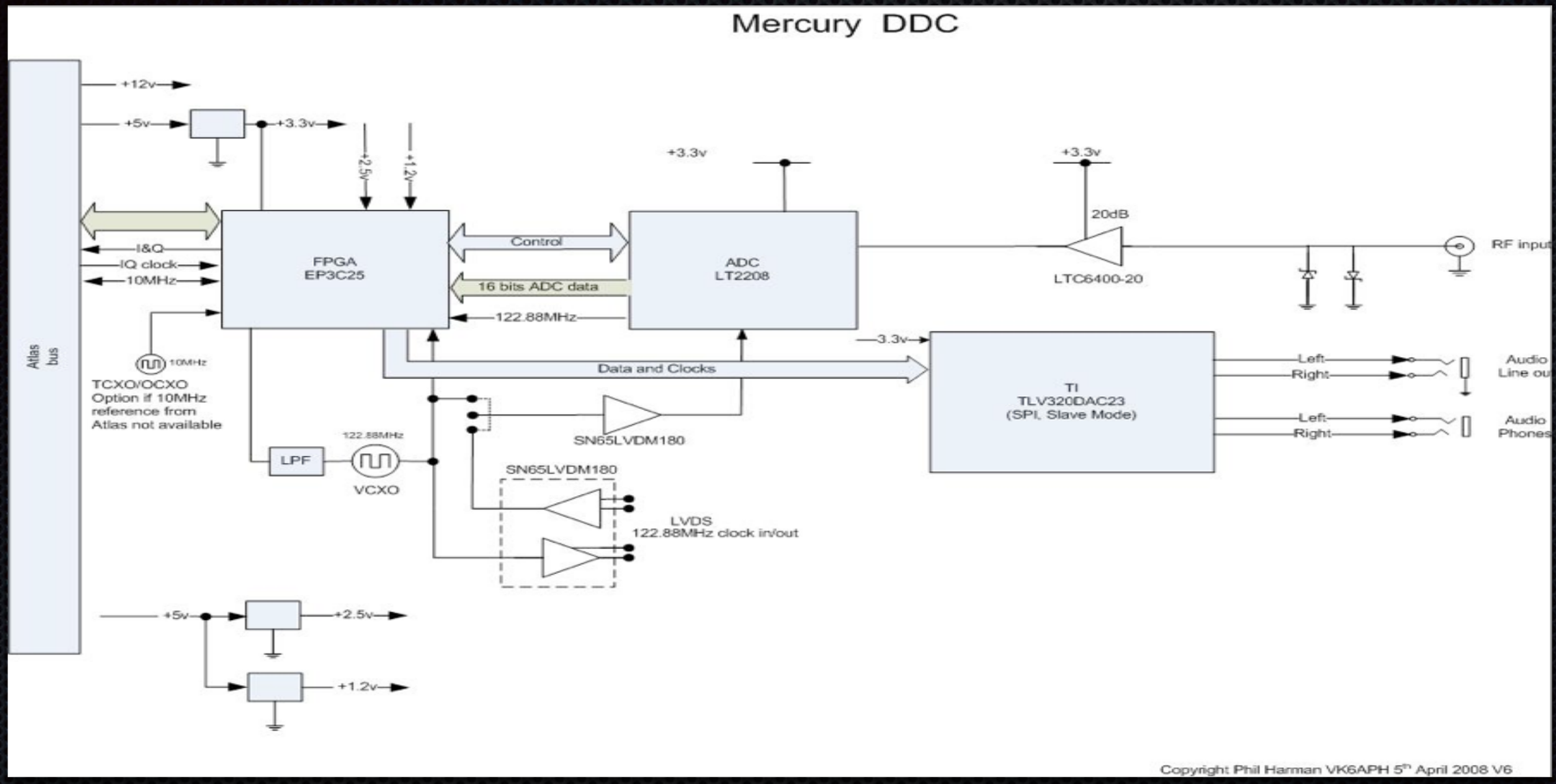
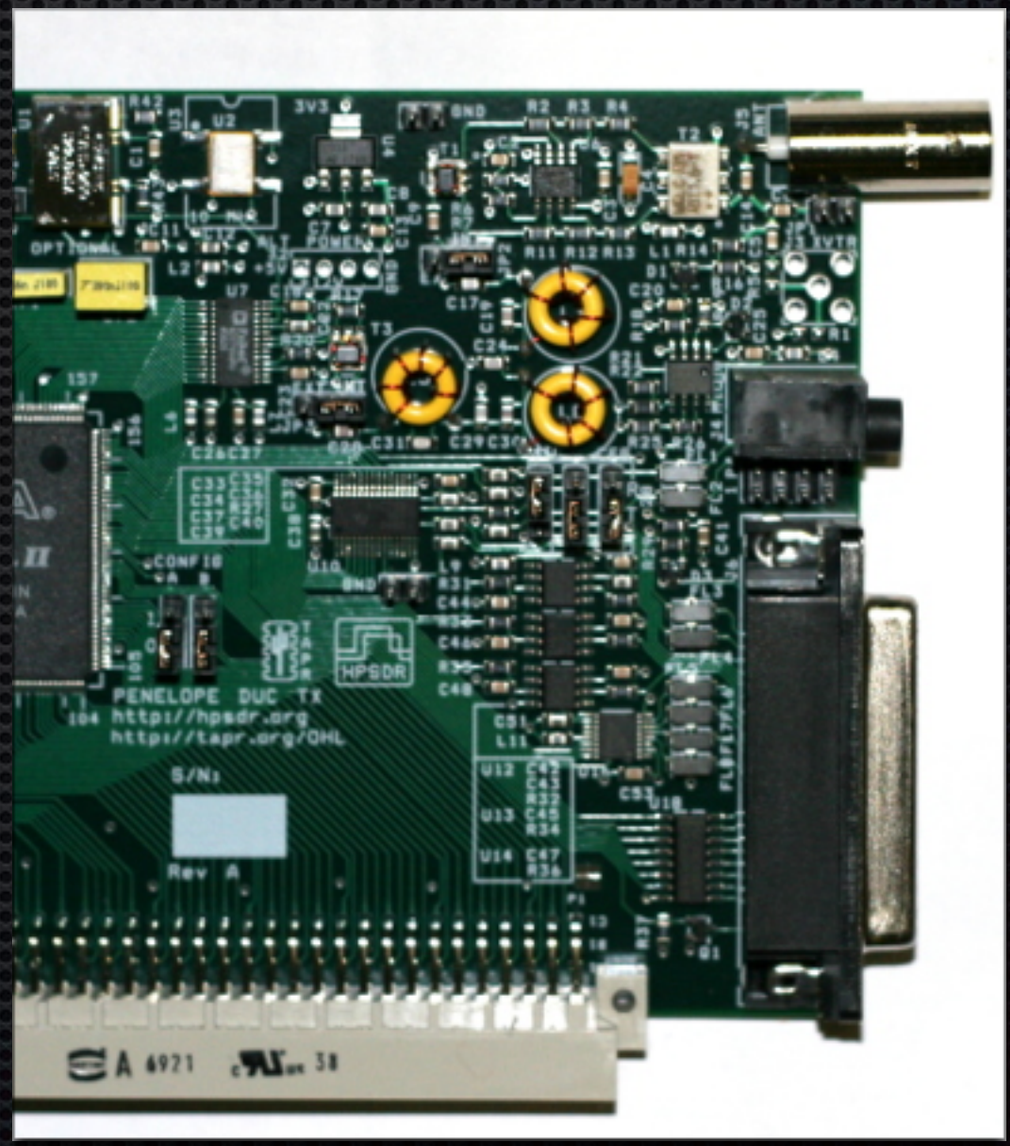
- Current firmware allows 4 receivers at 192kHz sample rate



Mercury Block Diagram

Penelope


PENELOPE DUC TX
http://hpsdr.org
http://tapr.org/OHL
S/N:
Rev A
HPSDR

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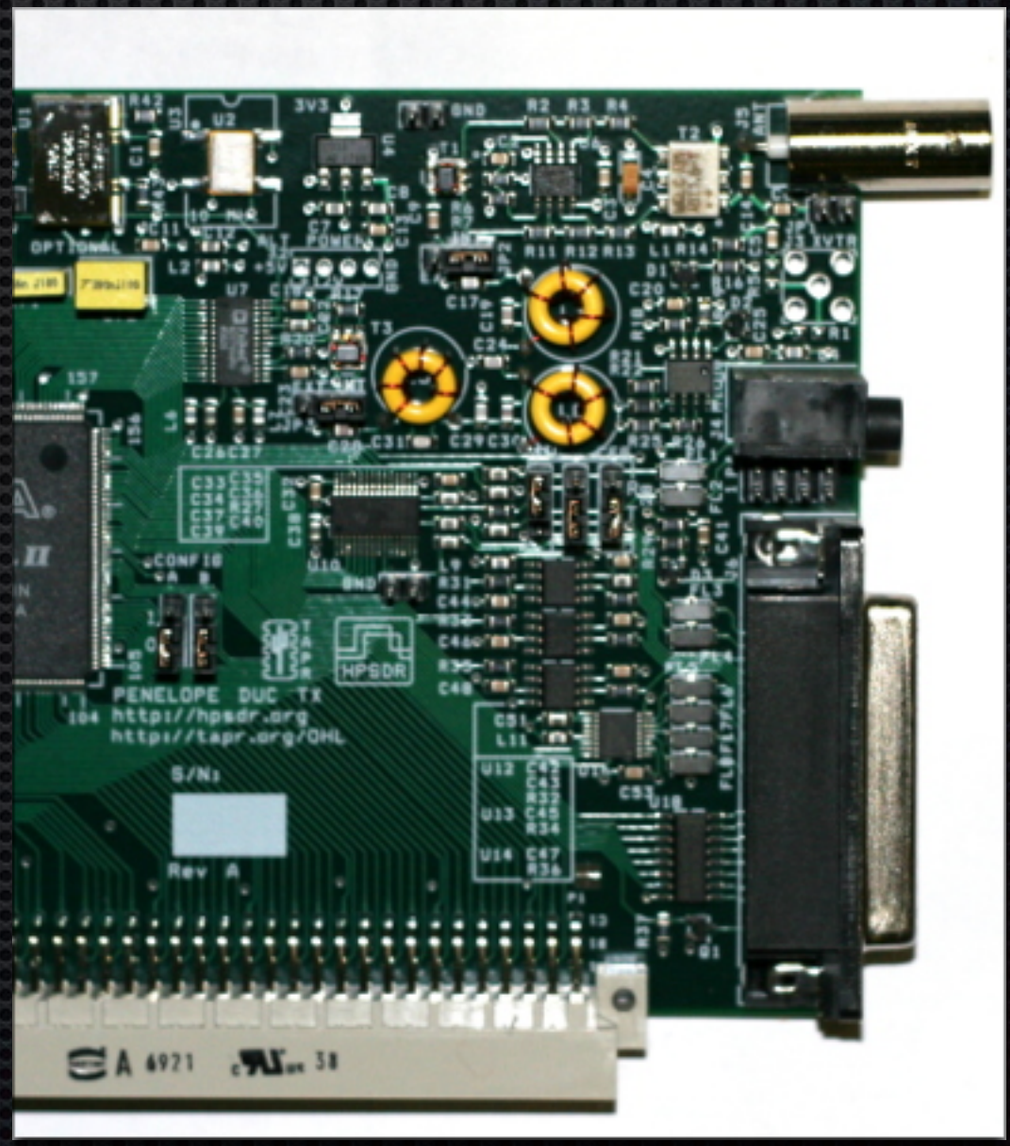
- AD9744 DAC as close to antenna as possible
  - 210 Msps 14-bit



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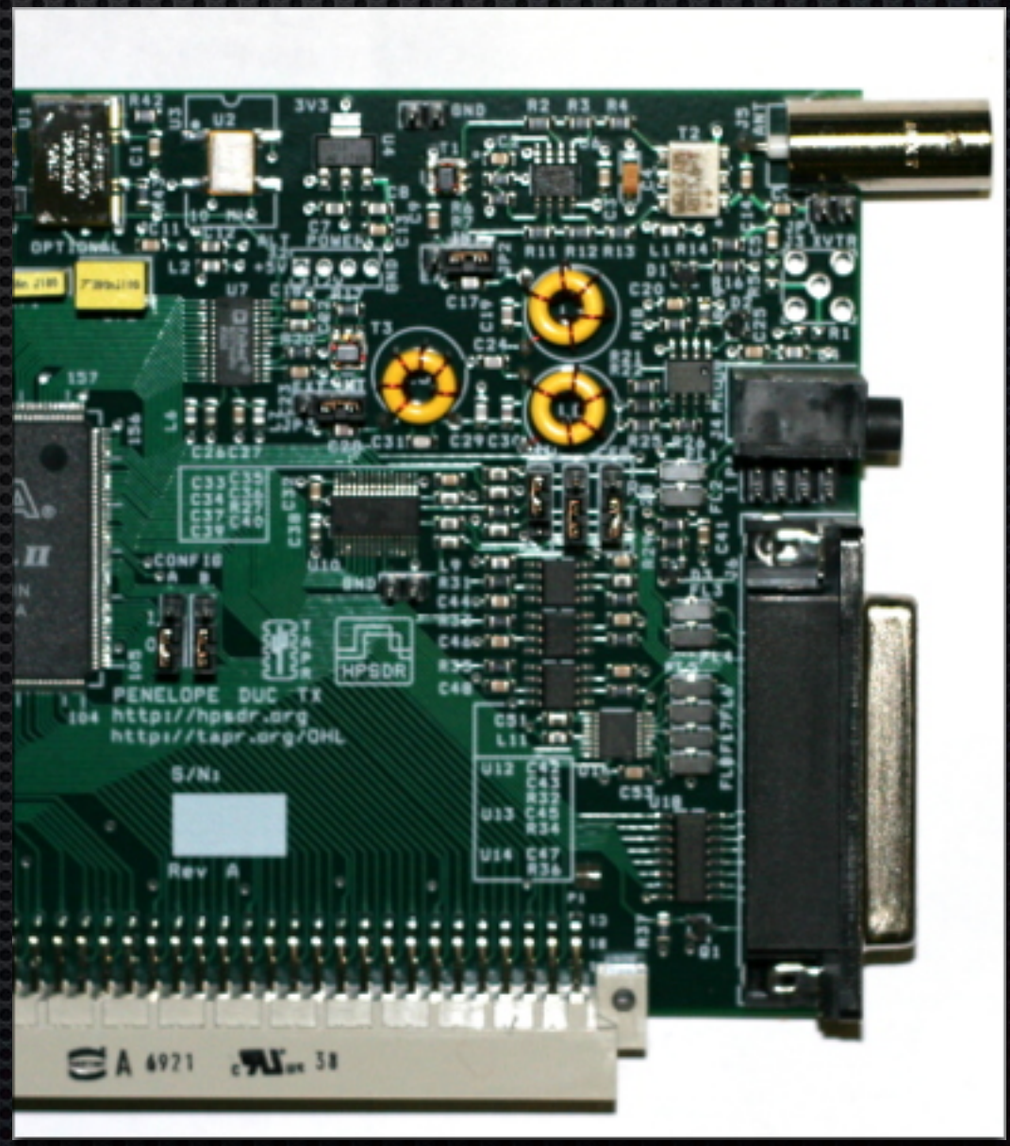
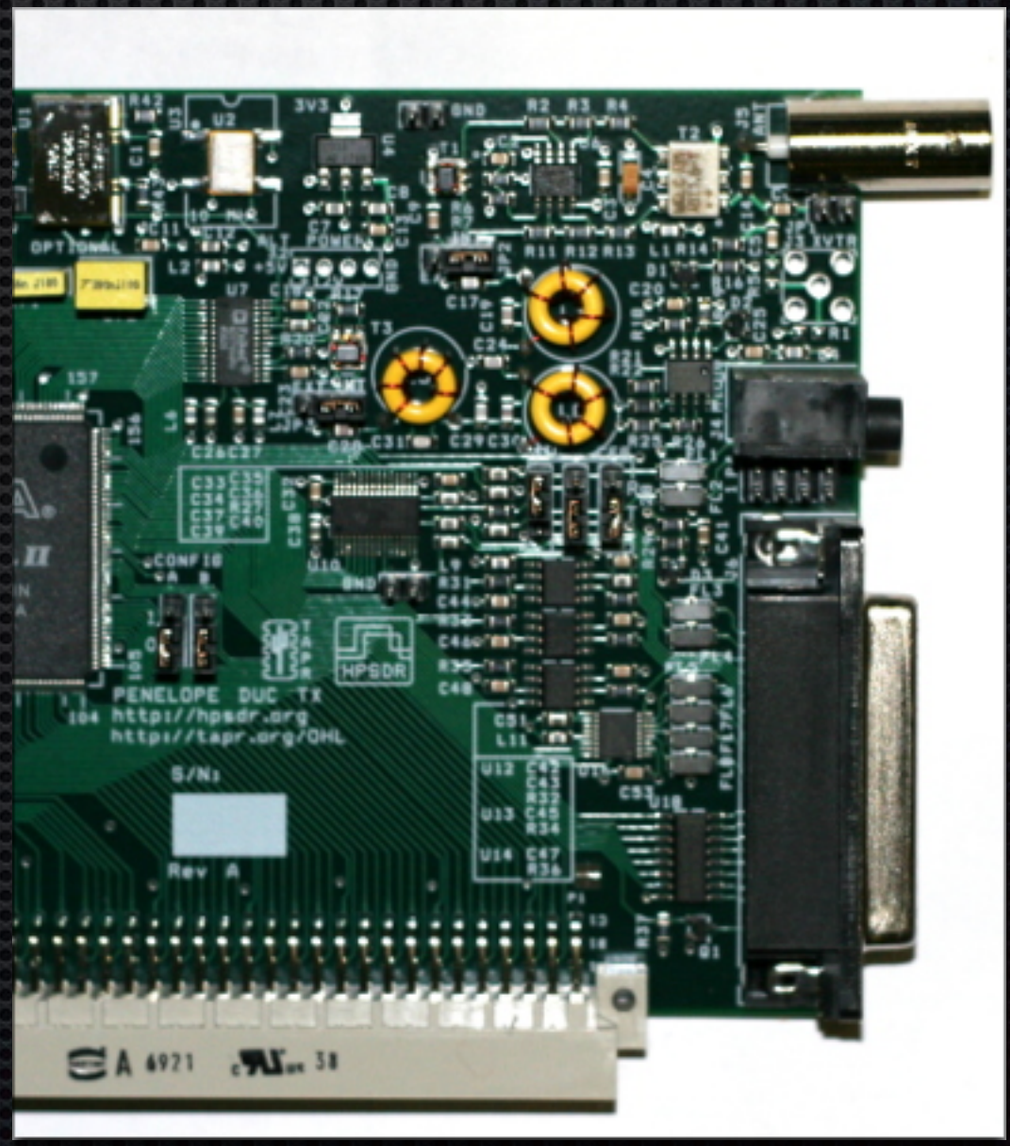
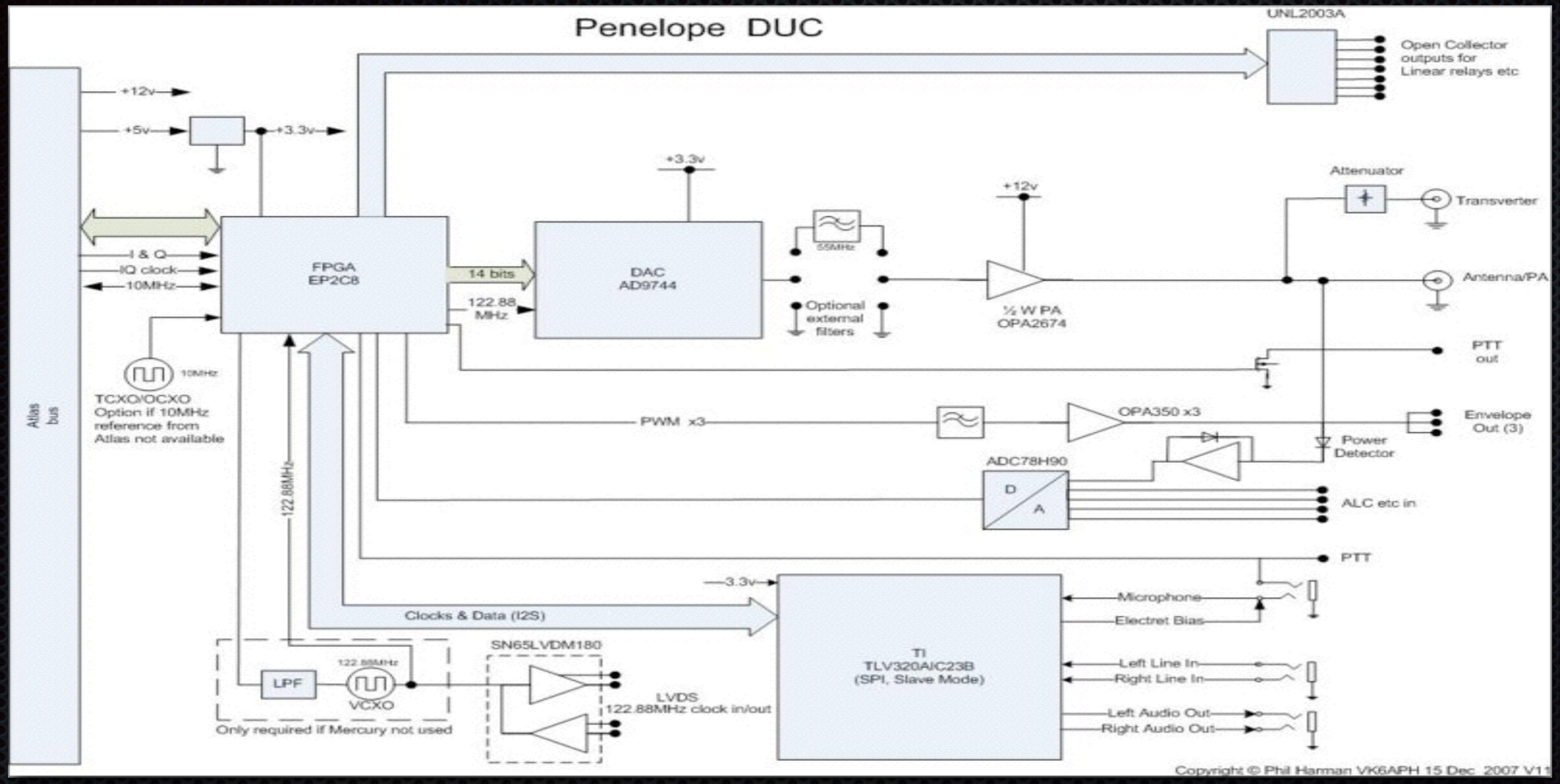


Penelope

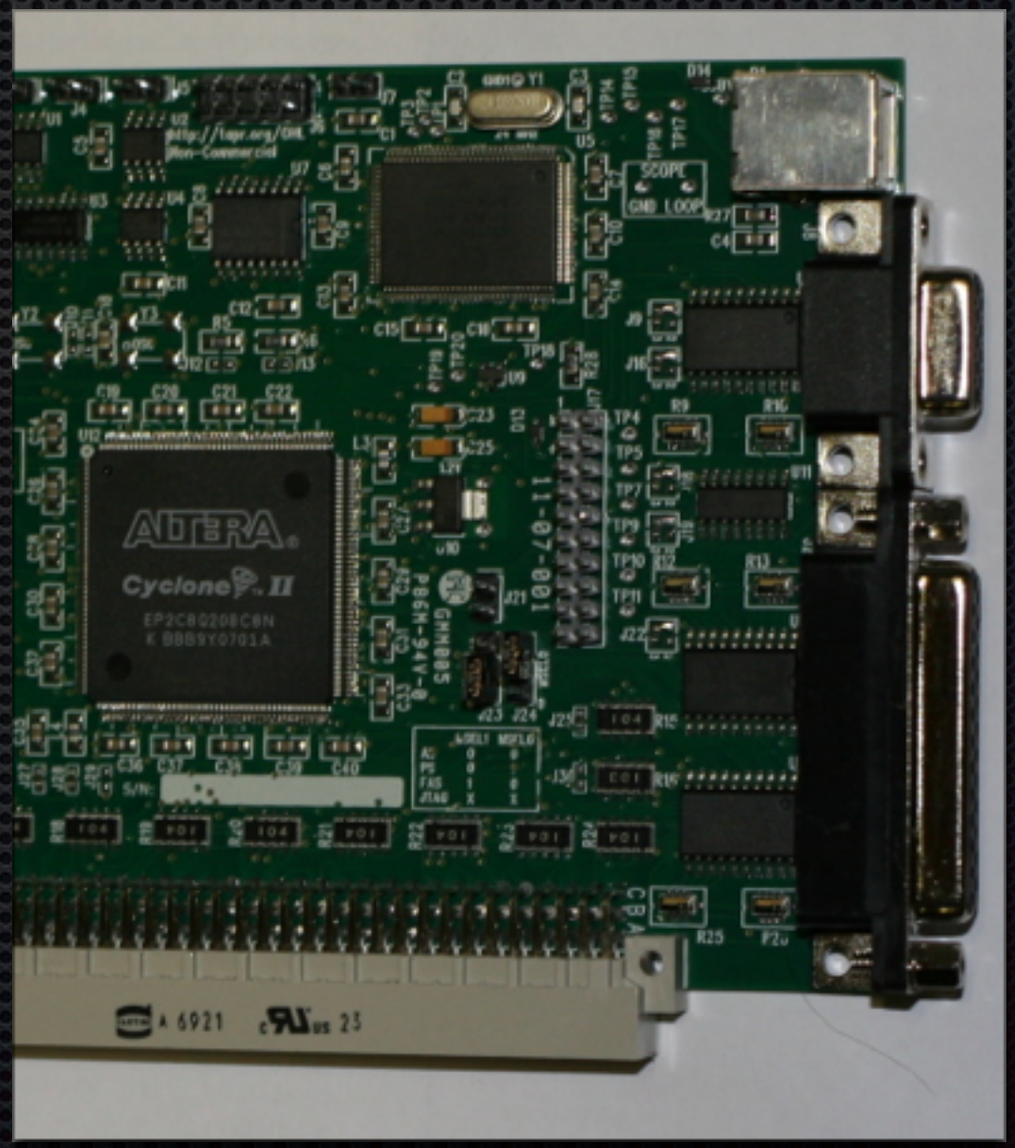
- AD9744 DAC as close to antenna as possible
  - 210 Msps 14-bit
- Altera Cyclone II FPGA
- Capable of transmitting multiple signals simultaneously





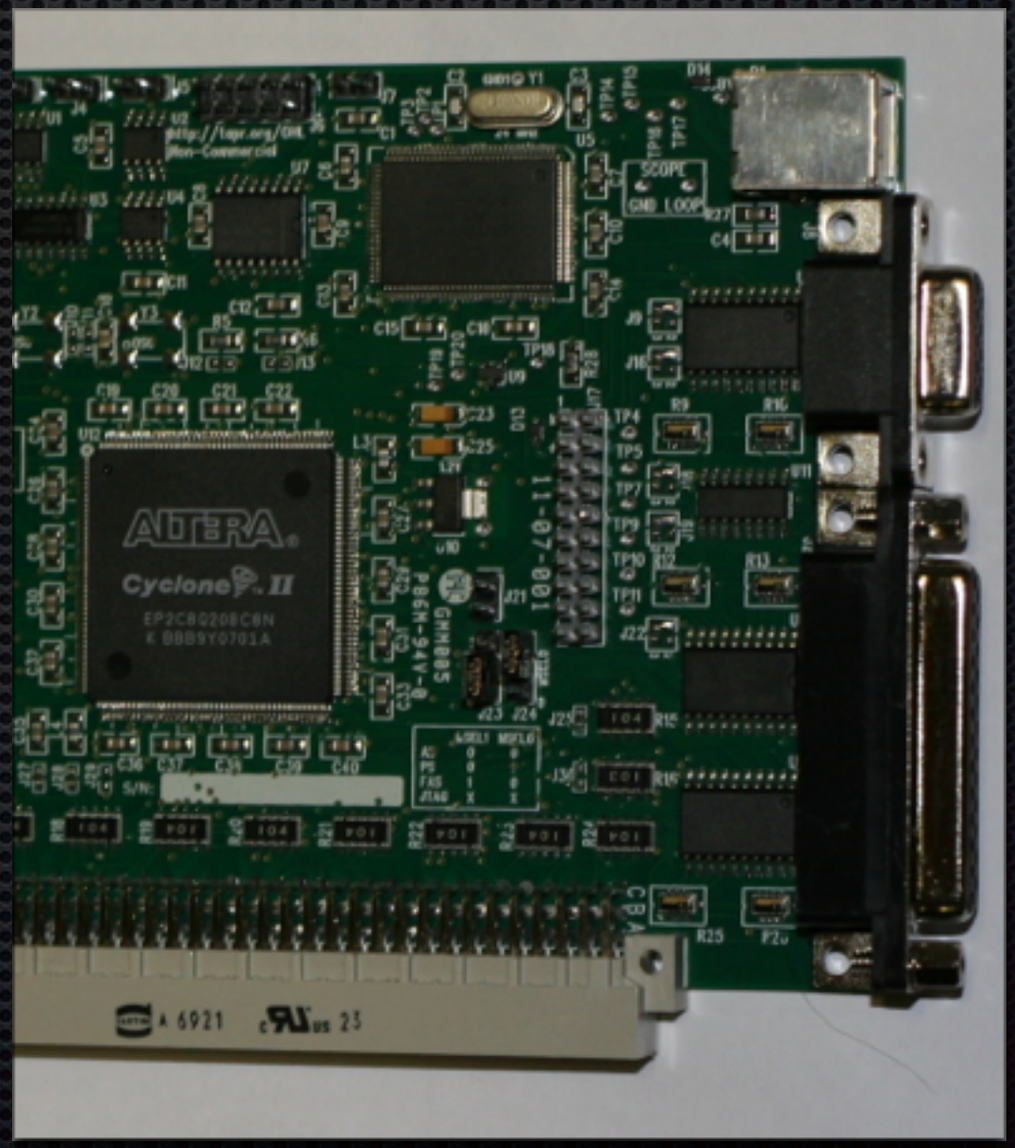
Penelope Block Diagram

Magister/Ozymandias



Magister/Ozymandias

- USB 2.0 connection with Cypress FX2



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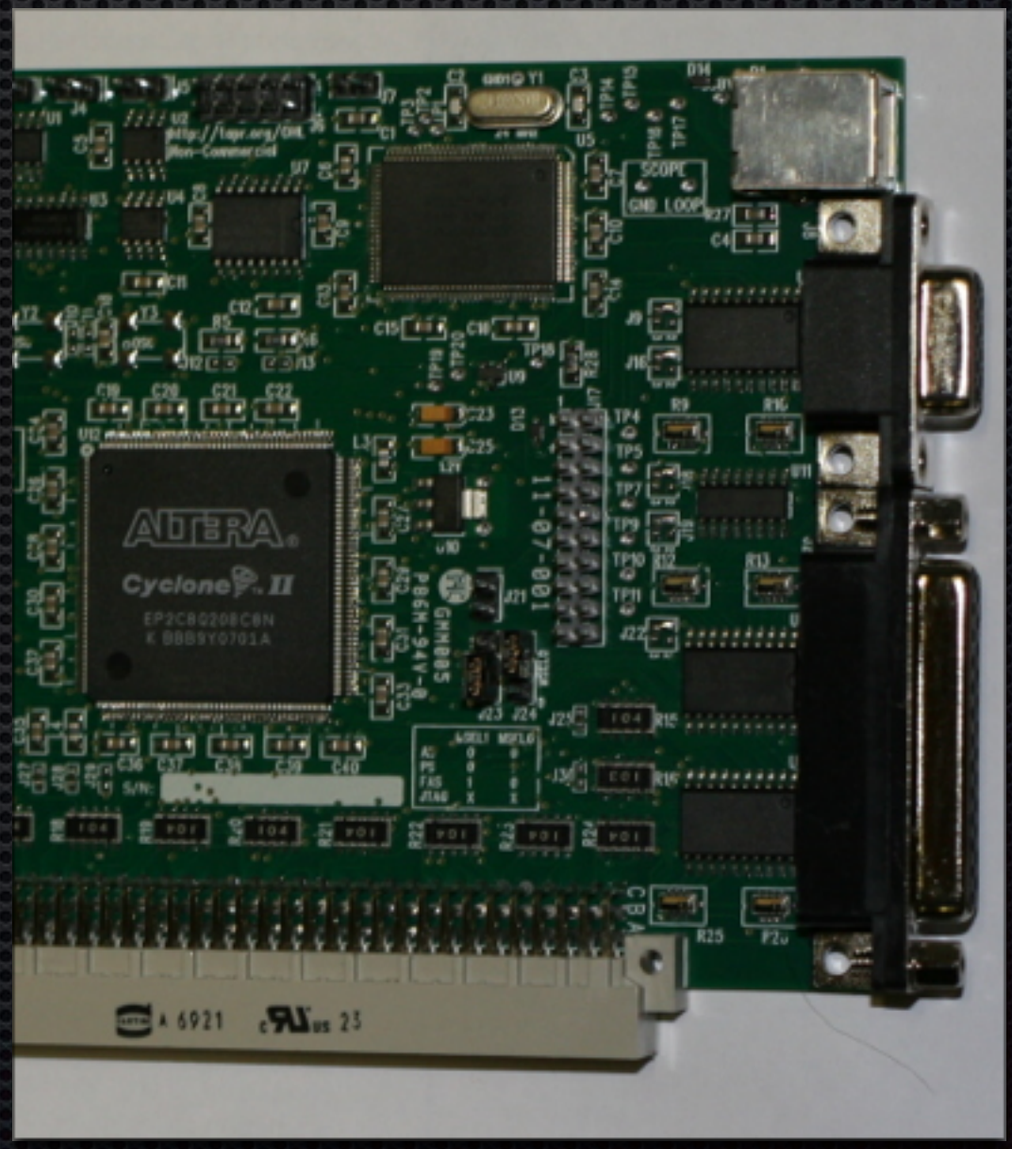

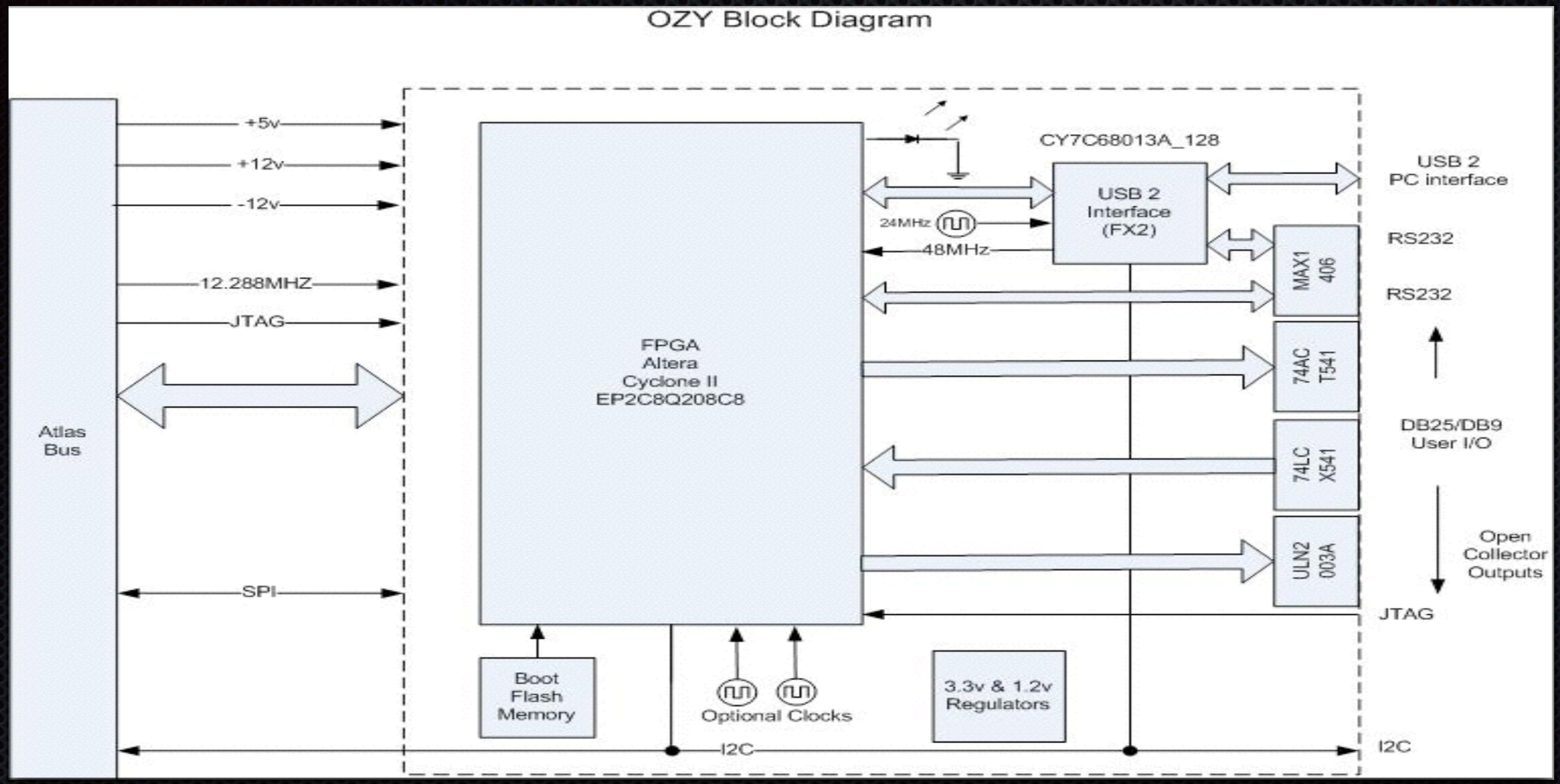

Ozymandias Block Diagram

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- Have a simple installation process
- Make the source code fully available

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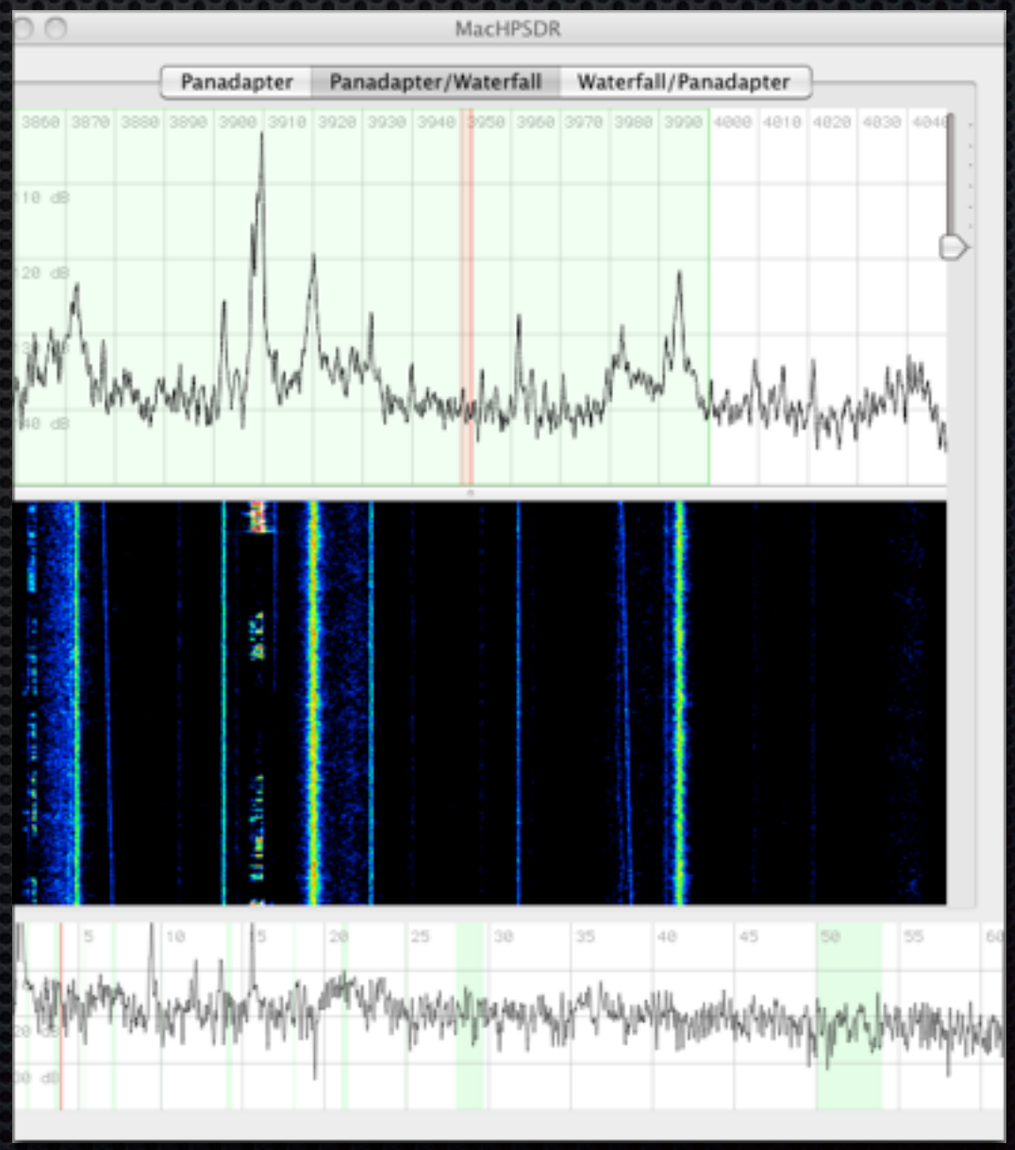
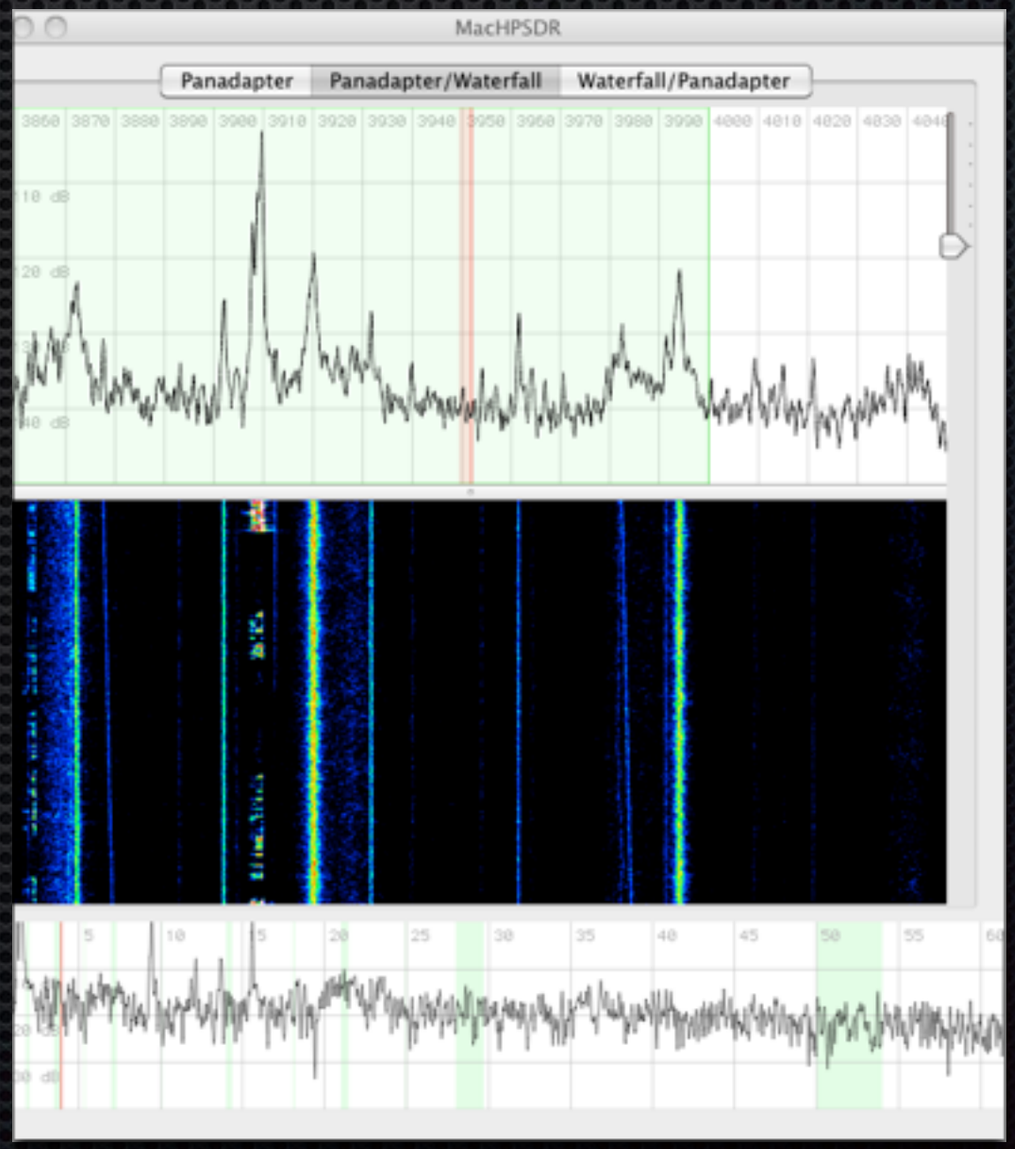
- Available at https://www.xenotropic.com/ham-svn/mac-ghpsdr

MacHPSDR


MacHPSDR
Panadapter
Panadapter/Waterfall
Waterfall/Panadapter

MacHPSDR

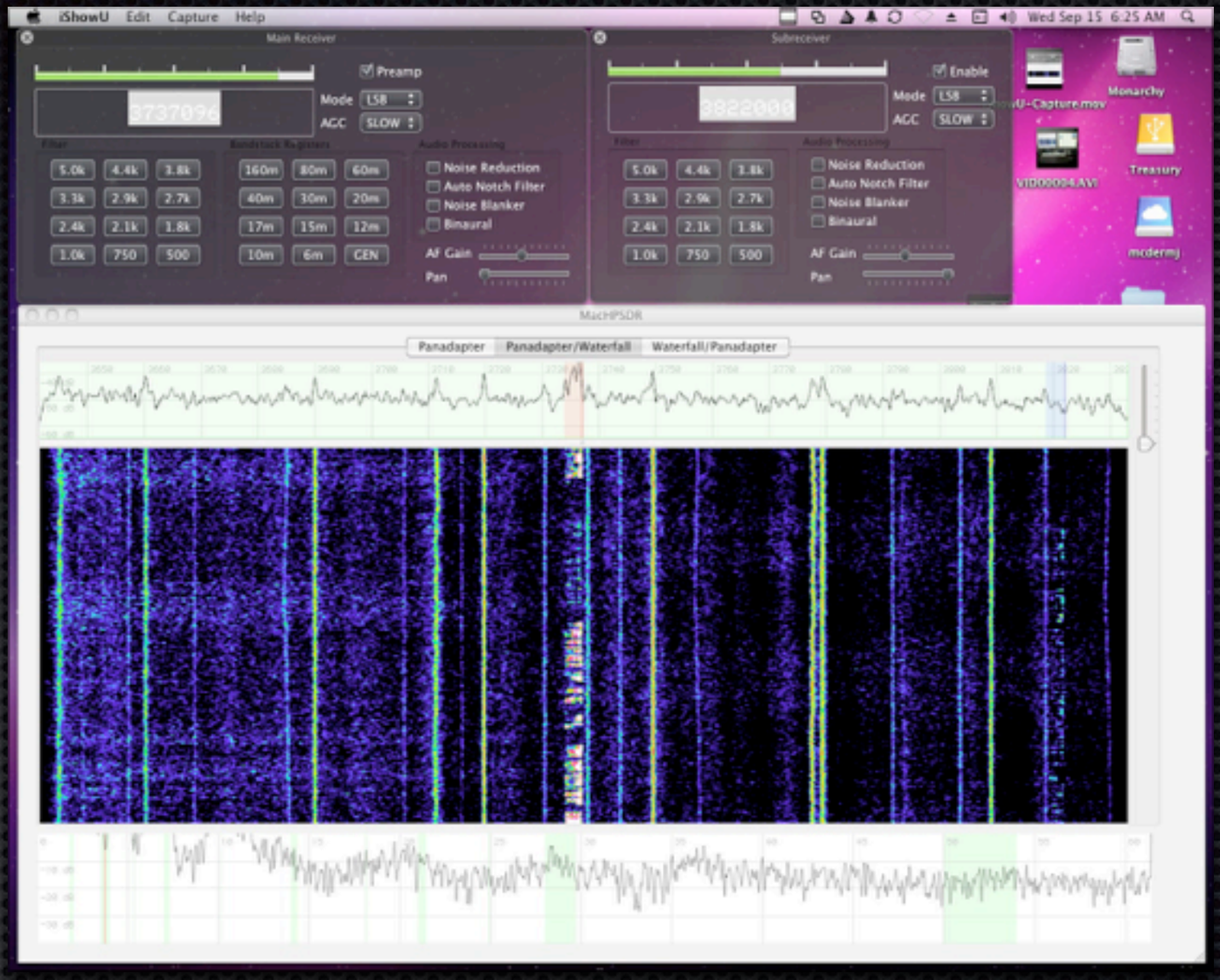
- Native Cocoa user interface
- Written in a mixture of Objective C and C
- Uses an improved version of the IOKit base from Mac-GHPSDR



MacHPSDR

Example Video

80m from Corvallis, OR 6:22 A.M. 9/15/2010



MacHPSDR

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Apple Technologies In Use

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- Objective C
- IOKit
- Cocoa
- Core Animation
- OpenGL
- Grand Central Dispatch
- vDSP
- Sparkle Updater

Objective C

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  - Ex: [transceiver changeFrequency:3500000 onReceiver:4]

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- Try to keep at least one transaction in the pipeline at a time
- Use realtime threads for reading and writing SDR data
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- Larger block sizes help reduce kernel ⟺ userland transitions

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- Standard application toolkit
- C-based Carbon toolkit will not be ported to 64-bit
- Interface is built with a tool that creates a “nib” file that defines the objects on screen

Core Animation

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- Layers can use a variety of drawing technologies

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- MacHPSDR's panadapter draws the signal line with OpenGL into a Core Animation layer

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- Not used extensively in MacHPSDR because you can’t make “real time” GCD queues

vDSP

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- Functions include FFT, convolutions, complex number manipulation, decibel calculations

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- DSP Rework is a redesign of the DSP functions that DttSP performs
- Rewritten using OO concepts with Objective C
- Extensively leverages the vDSP functions

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Future Technologies

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- OpenCL
- Core Audio
- Distributed Objects

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- Computing units include the CPU, GPU, and even some custom designed IBM Cell boards
- Included in Snow Leopard
- GPGPU is difficult for SDR because of small block sizes

OpenCL + OpenGL

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- Both standards maintained by the Khronos Group

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- Both standards maintained by the Khronos Group
- OpenGL can use the same buffers as OpenCL

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- Audio Units can be embedded in any program
- Stock audio units include a 31 band equalizer, a compressor/limiter

Distributed Objects

Distributed Objects

- Allows Cocoa objects in different programs to communicate
- Similar to remote procedure calls, but on the same machine
- Hope to use this to integrate with logging software and other external programs

Future Directions

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- Integration with logging software
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- Ichabod — the headless MacHPSDR

How Do I Get MacHPSDR

How Do I Get MacHPSDR

- Binary Distribution at www.nh6z.net/MacHPSDR/MacHPSDR.zip
- Source in Subversion: https://www.xenotropic.com/mac-svn/MacHPSDR

Documentation

Documentation

- There is none!
- Could use an intrepid soul to help with the help files

How to Contribute

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- Patches are accepted by e-mail and reviewed
- As time goes on, and if there is a critical mass of developers, SVN write access will be granted
- Bugs are tracked on Lighthouse at mcdermj.lighthouseapp.com
- The OpenHPSDR wiki is always a good place to contribute