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# UHFSDR + USB2SDR = Flexible IF Rig

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# Why UHFSDR?

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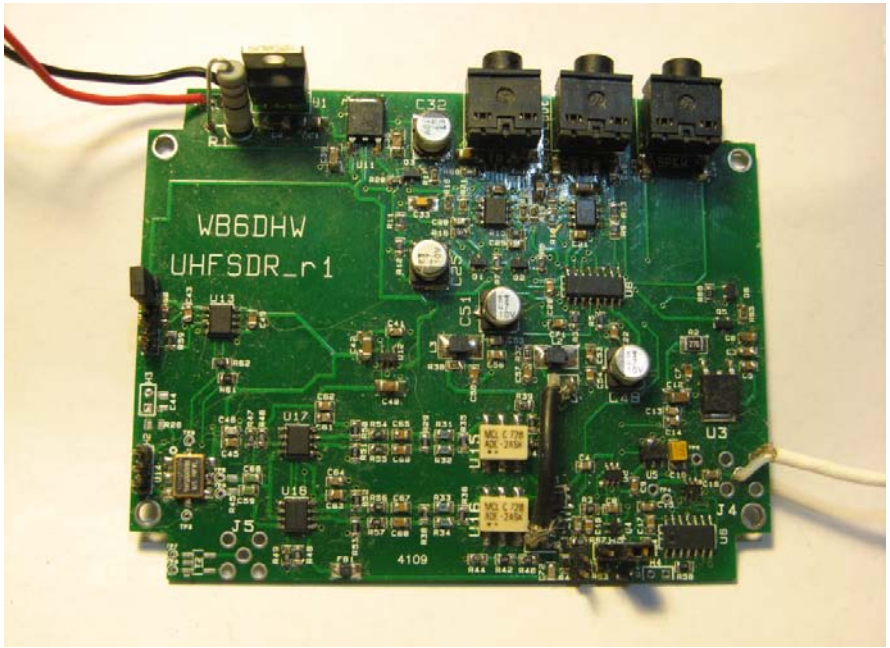
- **Wanted IF rig**
  - SDR
  - Buildable
  - Simple
  - Frequency flexibility




- **Enter UHFSDR**
  - 1.75 - 700MHz (1/2 Si570 output)
  - 50 mW Transmit out
  - 2dB Noise Figure LNA

# UHFSDR Info



- **Developer**
  - David Brainard - WB6DHW
  - http://wb6dhw.com/For_Sale.html
  - http://groups.yahoo.com/group/UHFSDR/
- **Key Design Features**
  - Separate I and Q conversion with passive MCL ADE-2ASK passive mixers (not QSD)
  - Pair of SY10EP52 D flip-flops create quadrature LO from Si570's differential pecl output
  - ADUM1258 provides isolation for $I^2C$ connection for Si570 Frequency control

# Limitations



- External RF filtering needed
  - No onboard RF filtering
  - Squarewave LO with fast rise-time insures lots of harmonics
- Si570 Performance
  - Gaps in frequency range :Grade A covers 10 to 945 MHz, 970 to 1134 MHz, and 1213 to 1417.5 MHz.
  - Crystal derived but not lockable to external reference
  - Temp stability spec'ed at +/- 50, 20, or 7 ppm -40C to +85C and priced high for better parts
  - Seems good up to 150 MHz but kind of bouncy at 450MHz
  - Touch the package and see immediate shift

# Phase Noise

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- Specs for phase noise look OK for UHF

Table 8. Typical CLK± Output Phase Noise (Si570)

| Offset Frequency (f) | 120.00 MHz LVDS | 156.25 MHz LVPECL | 622.08 MHz LVPECL | Units |
|---|---|---|---|---|
| 100 Hz | –112 | –105 | –97 | |
| 1 kHz | –122 | –122 | –107 | |
| 10 kHz | –132 | –128 | –116 | |
| 100 kHz | –137 | –135 | –121 | dBc/Hz |
| 1 MHz | –144 | –144 | –134 | |
| 10 MHz | –150 | –147 | –146 | |
| 100 MHz | n/a | n/a | –148 | |

# UHFSDR Build Considerations

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- Some parts orientation are not clear form the silk screen or overlay and may require close examination on example photo
- Some parts have alternative choices and the kit parts may not match the nominal BOM parts.  Especially for RF switches. Check the marking to make sure the control line jumper is correct for your part
- PA inductor may need modification to reach some frequencies of interest, may need several values in series to present wideband high impedance to the PA

# Interface Solution

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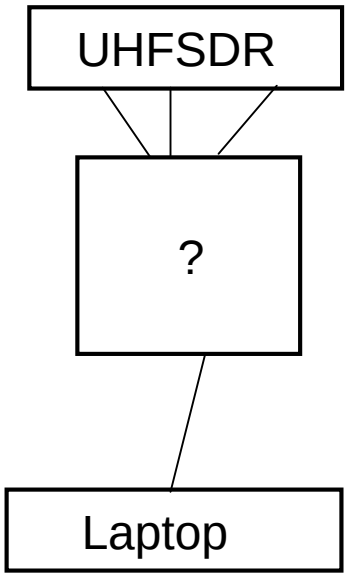
- Need Laptop interface
  - IQ in and out
    - 24 bit (preferred)
    - 192ksps (preferred)
  - USB
  - Extra IO lines
    - I2C freq control
    - Filter selection
    - T/R switching
  - Simple cabling
  - Software Support




- Options Considered
  - SDR WIDGET
  - USB2SDR

# SDR Widget

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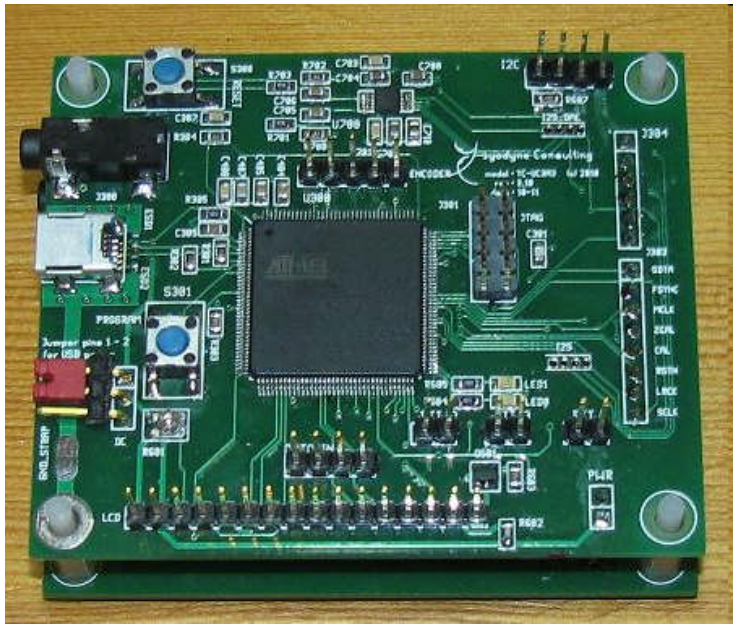

- Hardware Features
  - 24-bit AK5384A ADC (135 dB)
  - 24/32 bit ES9012 premium DAC
  - I2C control bus
  - 3 optocoupler buffered inputs
  - 3 mosfet 'contact' outputs
  - Connector for rotary encoder
  - 16-bit LCD panel interface
- Software Features
  - Support 24-bit 48k/96k/192k sample rates on Linux and MacOS
  - Support Windows at 48k sample rate
- Developer George Boudreau
  - http://www.yoyodyneconsulting.ca/pages/SDR-Widget.html

# USB2SDR

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- Hardware Features
  - Up to 192 ksps including Windows
  - 92 dB ADC
  - I2C port with 8 I/O lines
  - jack for a straight key or paddles
  - USB PC Connection
  - Connection for optional 24 bit ADC
  - 4 audio input, 4 audio outputs
  - NATIVE SUPPORT for PowerSDR-IQ
  - Factory assembled

- Developer Christos Nickolaou SV1EIA
  - sv1eia at gmail.com
  - http://groups.yahoo.com/group/powersdr-iq/

# And the Winner is…

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- No surprise here (if you read the title)
  - Comfort with the USB2SDR integration into PowerSDR-IQ
  - Positive reports using the UHFSDR and USB2SDR
  - (92 dB) ADC limitation but there is an upgrade path to a 24bit ADC (someday)
  - Still interested in the SDR Widget

# Complete System

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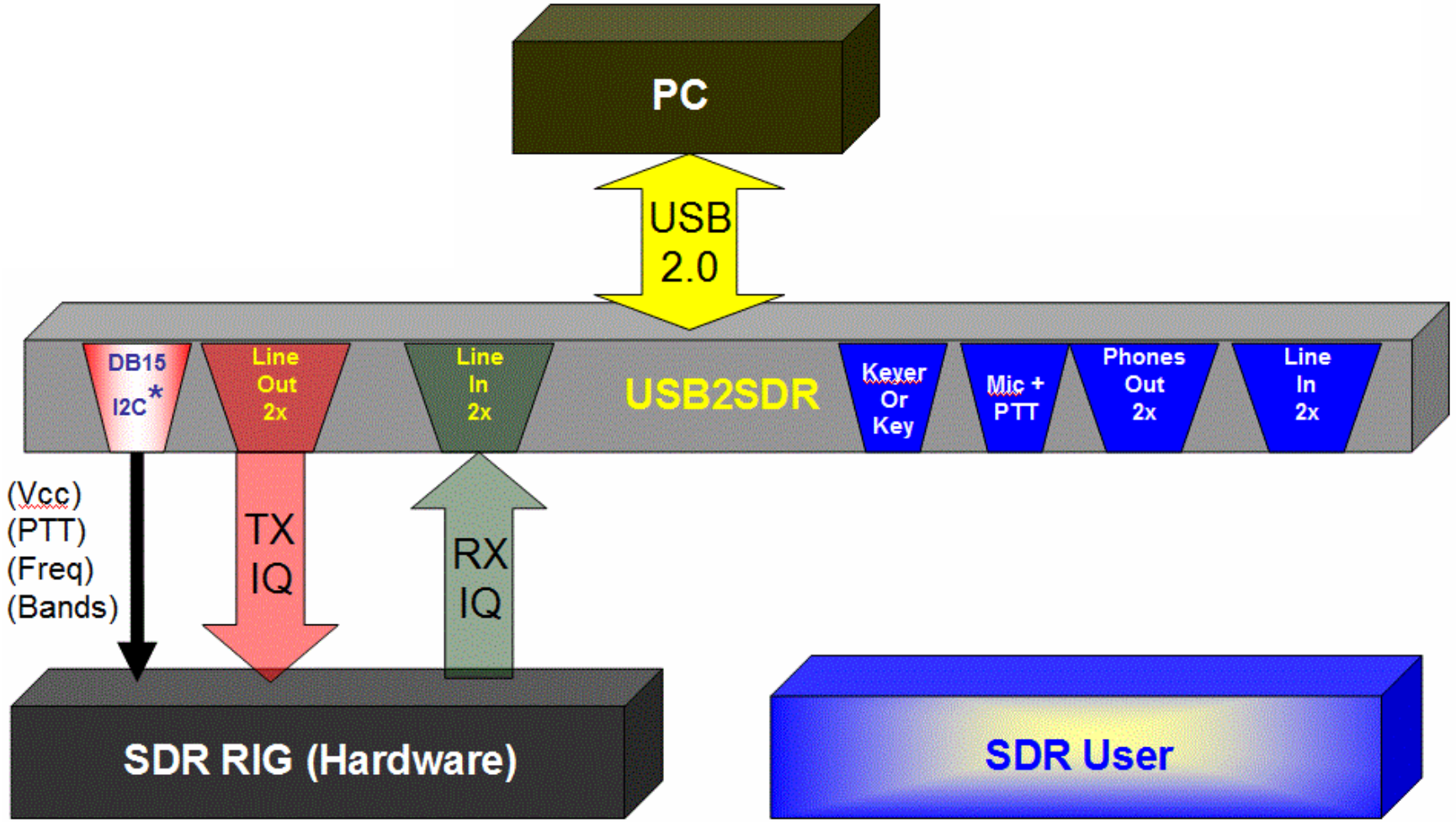

# Mechanical Construction



- Reused Lansing MicroPak C style case from Ham-com (originally had Sony gadget inside)
- Scrapped original contents for parts
- Attached Aluminum spacer to PCB’s
- Epoxied spacers to base plate (no drilling = no binding)
- Staggered board heights to avoid mechanical interference by cabling

# Front View

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# Side View

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# Top View

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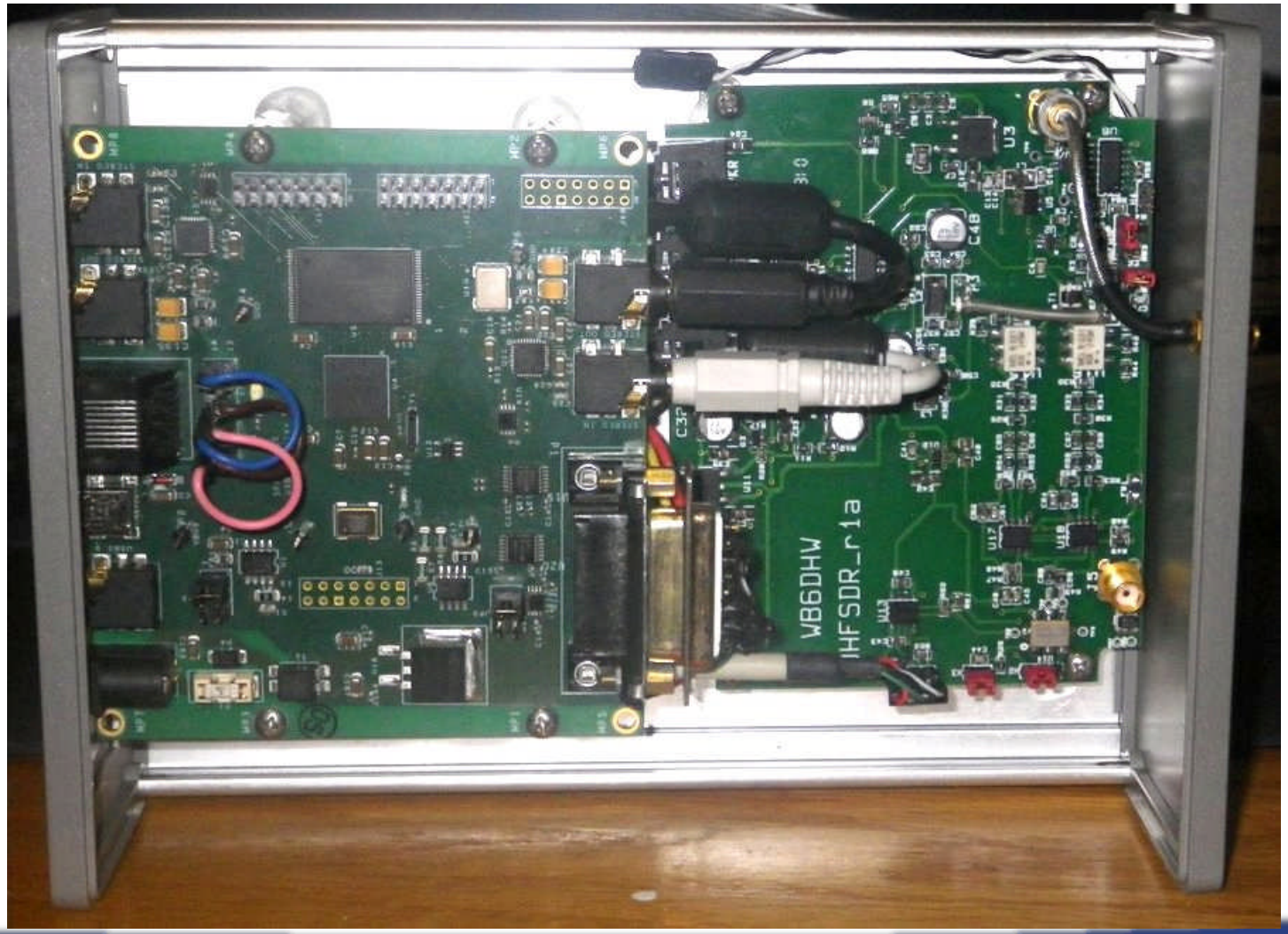

# Front Panel

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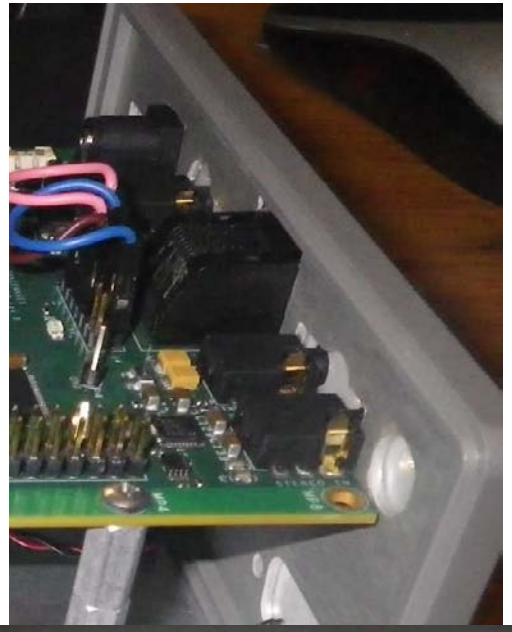
- Used nibbler tool to enlarge existing holes to fit USB2SDR
- Printed and laminated card stock to make panel face cover.
- Cut to size and cutout holes for connections
- Attached with no-foam doubles sided 3M tape



# Panel Holes

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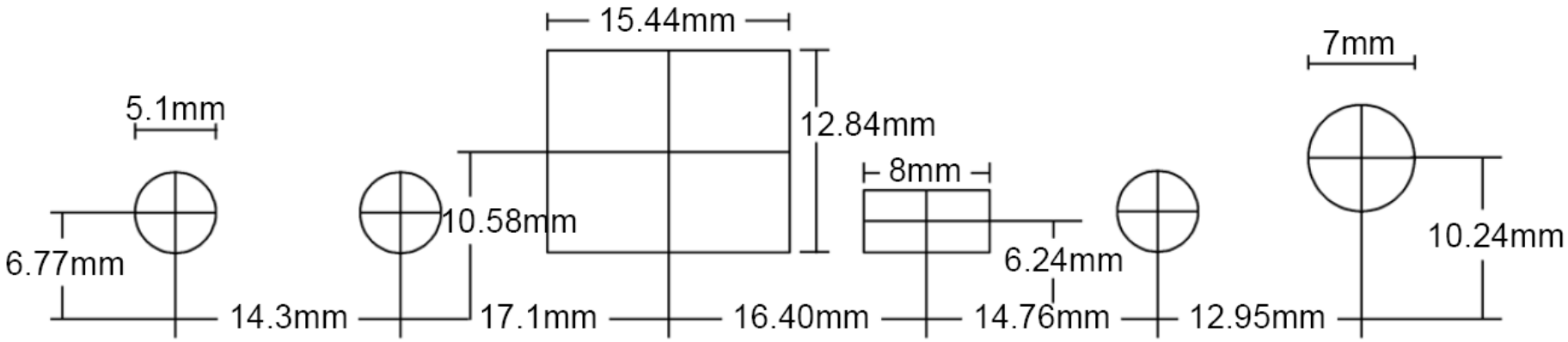

# Tools Used

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# Interfacing the Boards

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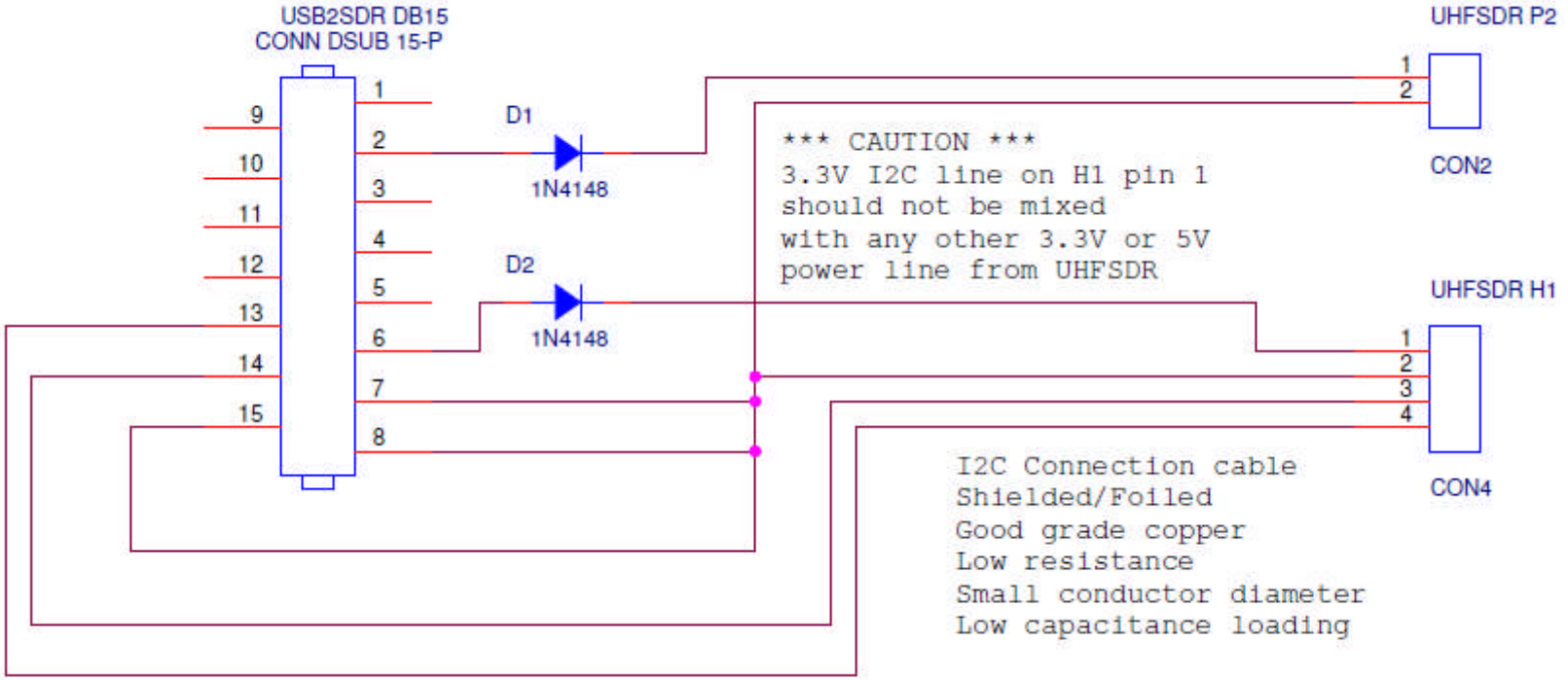

# Interfacing the Audio

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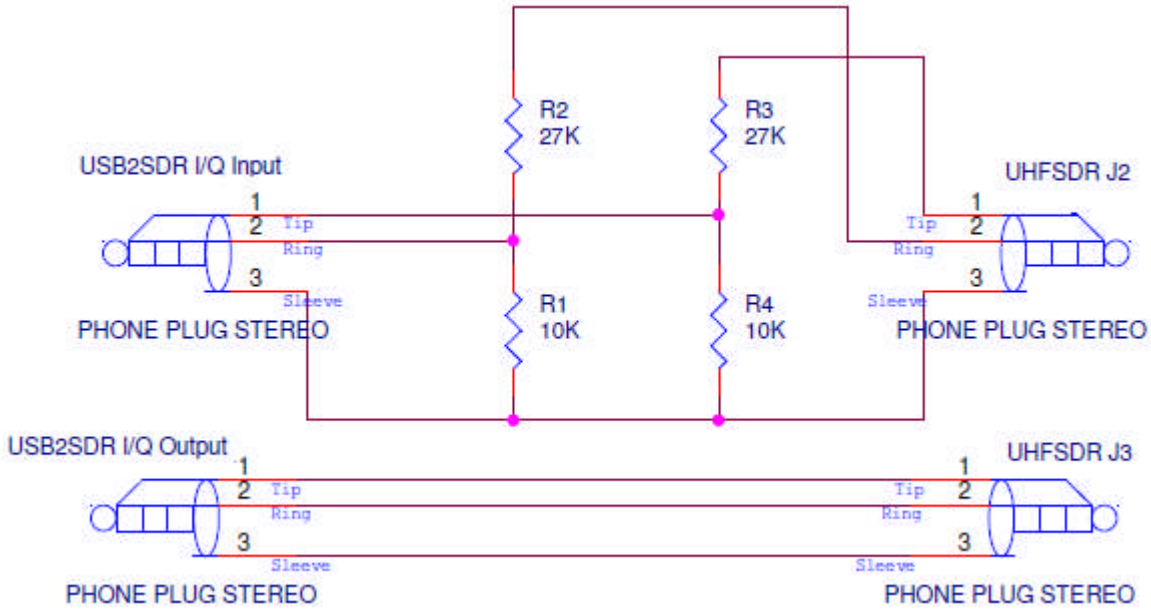
- UHFSDR Op-Amps Use 12Vdc, USB2SDR max input is 0.5Vrms, < 3.3V above ground, requiring pad down



# PowerSDR-IQ Setup

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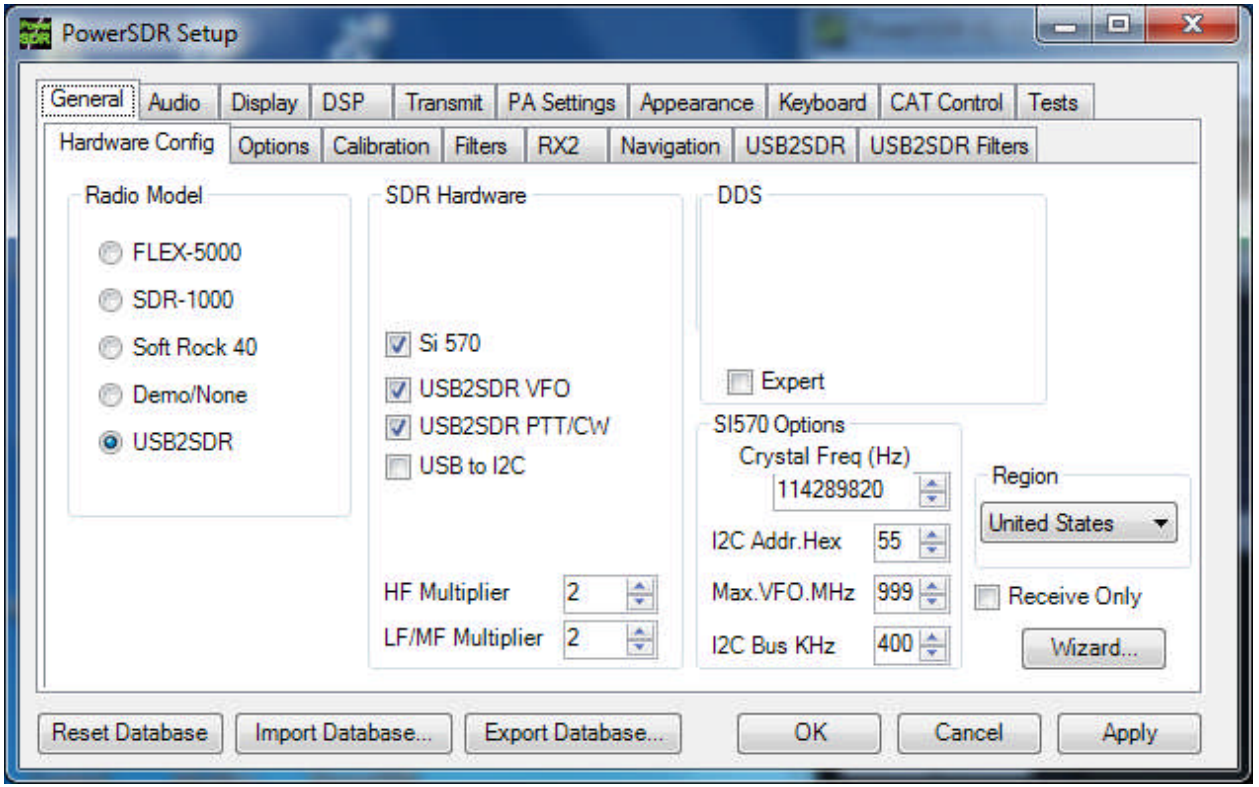

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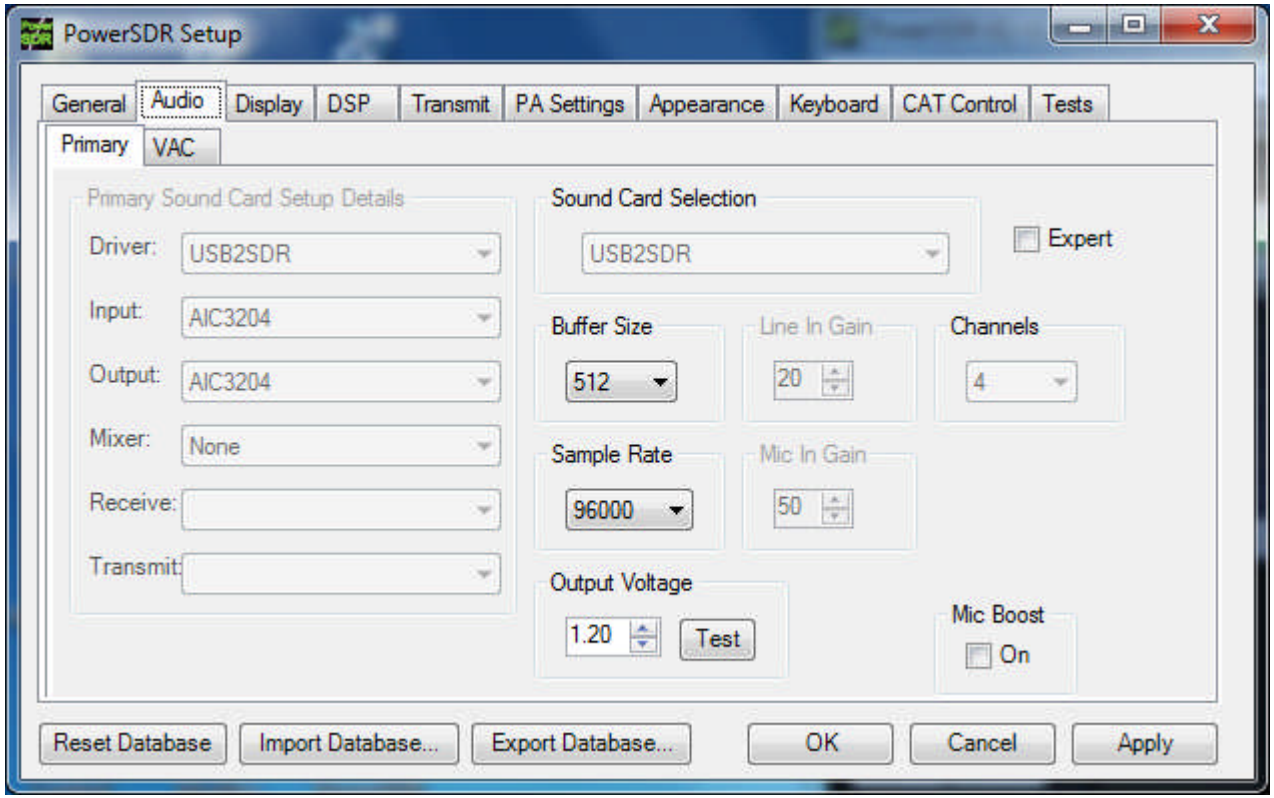

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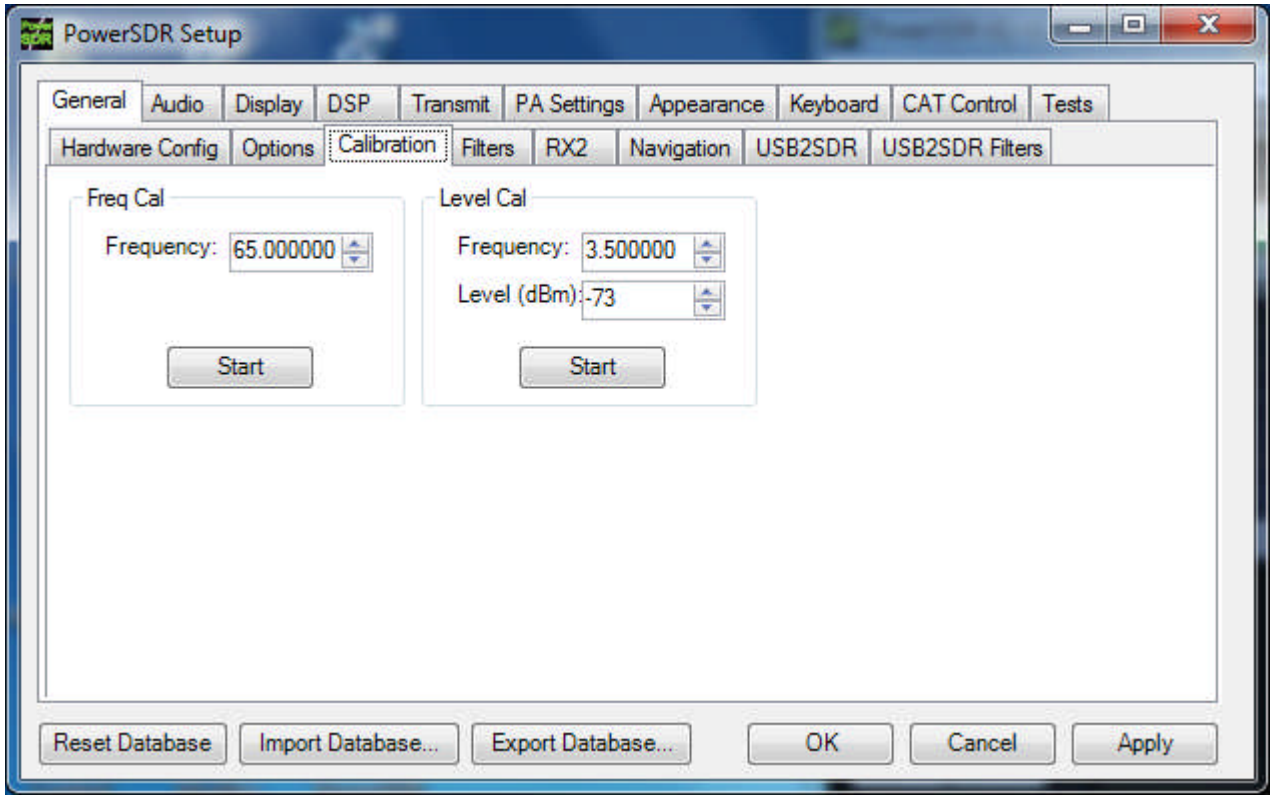

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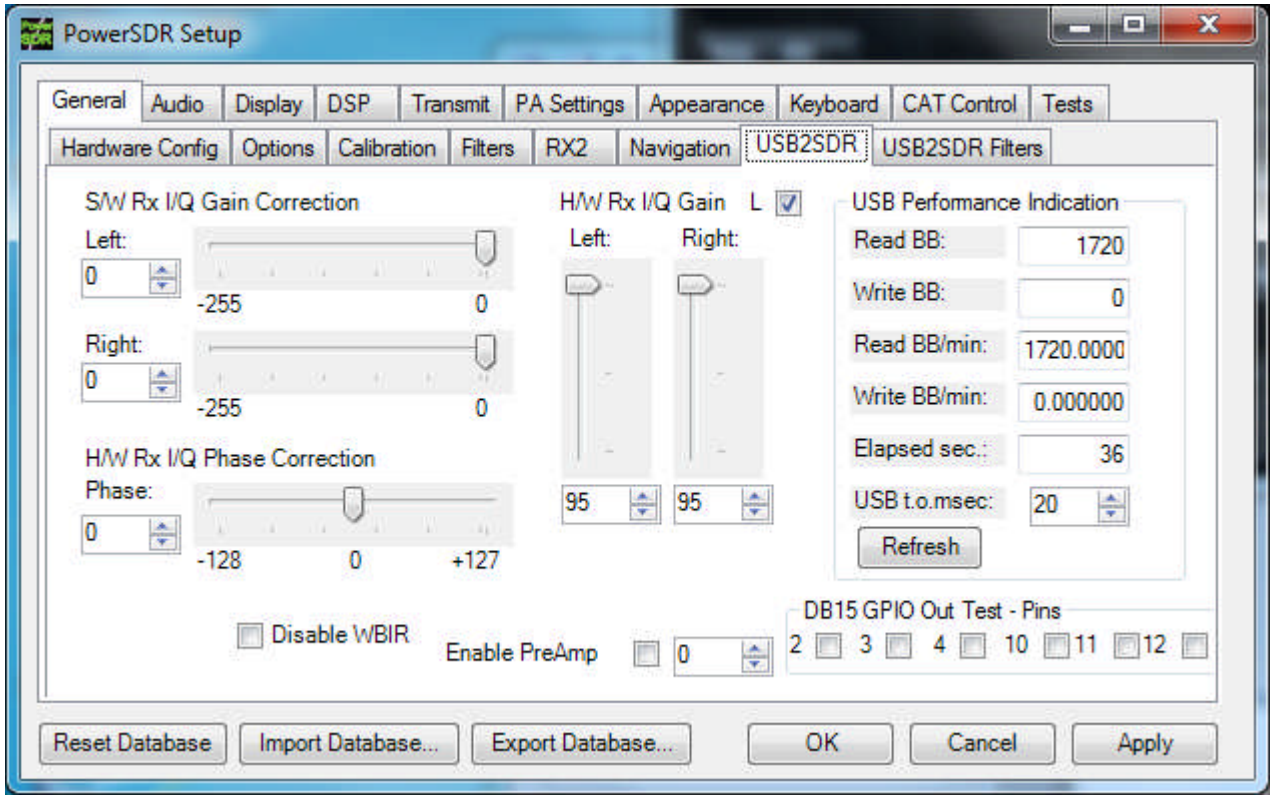

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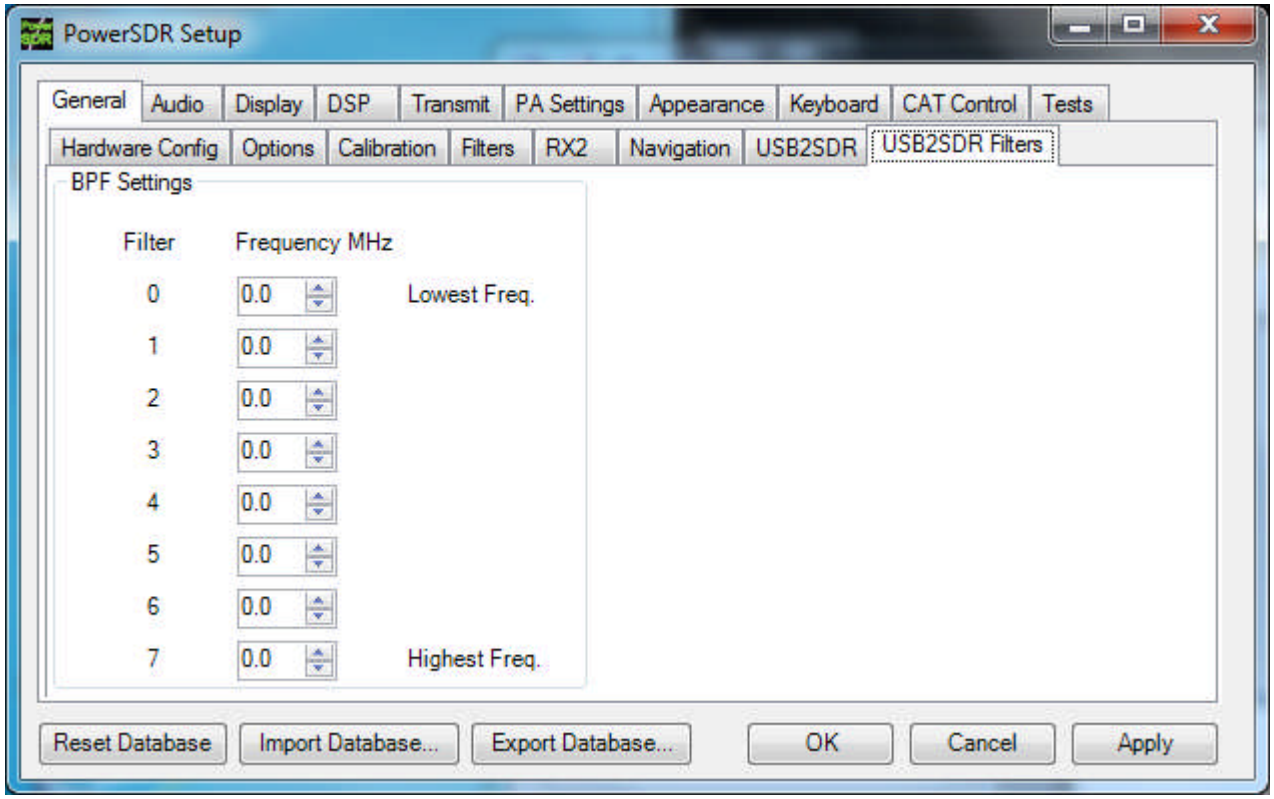

# PowerSDR-IQ

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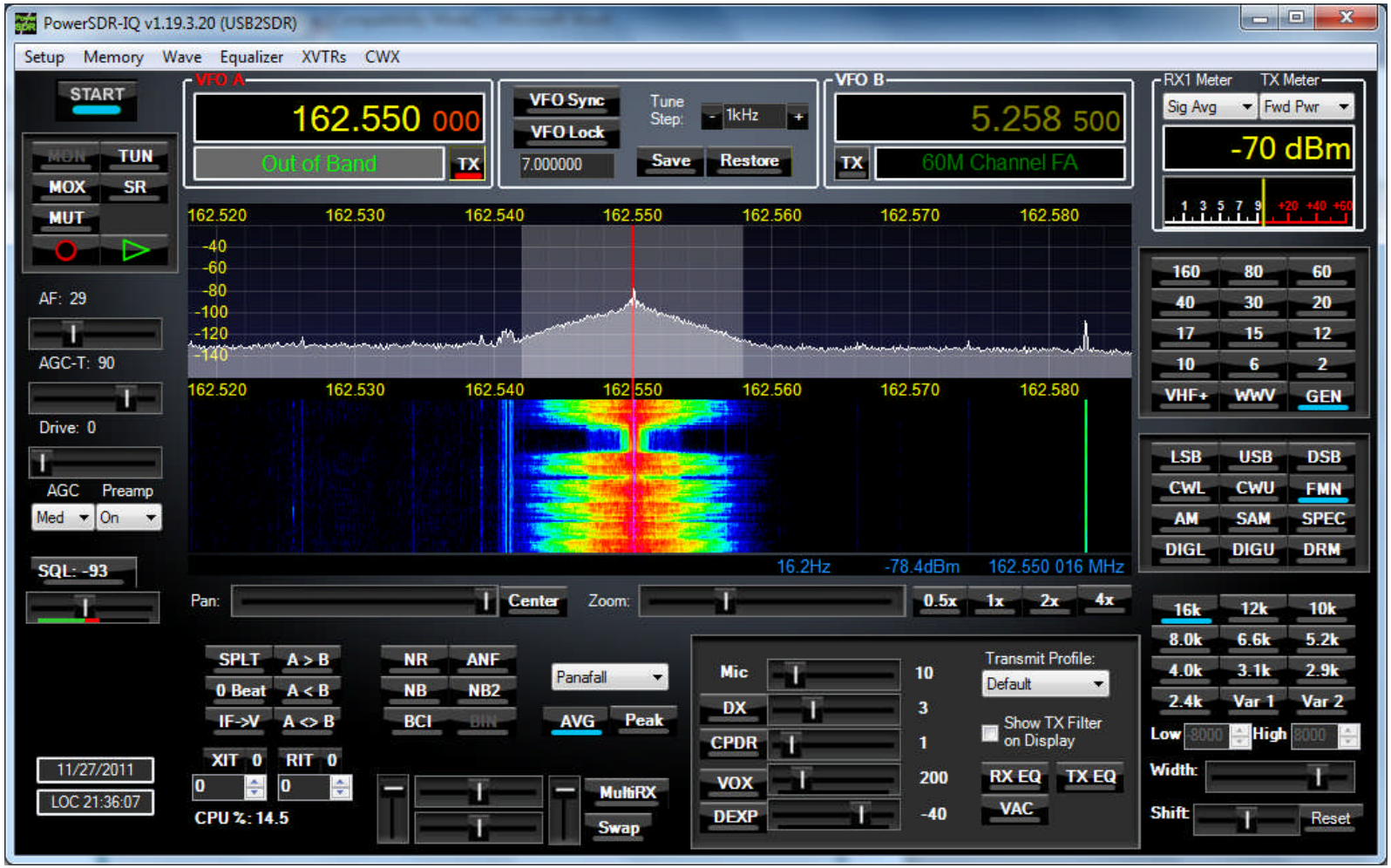

# Next Steps



- Filters for operating frequencies
- Characterize Si570 temperature vs frequency
- Experiment with temperature control
  - Insulation
  - Add thermal mass
  - Active controller
- 24 bit ADC option?
- Revisit SDR Widget?

# Questions?

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