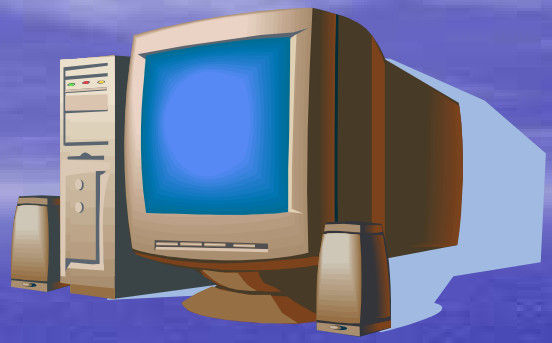
A New Ham Horizon- Software Defined Radio

Glen Whitehouse, K1GW
John Wettroth, KF4EUZ

Definition- What Is It?

- For this discussion- *A Software Defined Radio (SDR) is a radio where most of the signal processing is done in software in a general purpose computer- (A PC)*
- *The benefit of SDR is that you can change modes, experiment and play by just loading a new program- you don't need to modify your radio circuit*

What Do You Need?

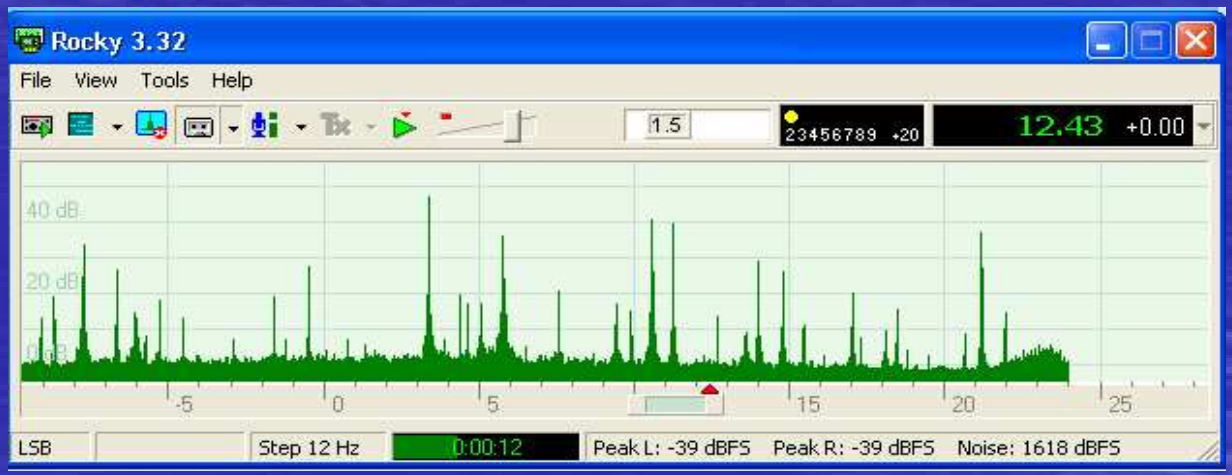


PC w/Software

- ✓PC w/Stereo Sound I/O
- ✓Software (Free)

Hardware

- ✓Antenna
- ✓SDR- Softrock 40 ($15)
- ✓Audio Cables
- ✓Power 12 VDC

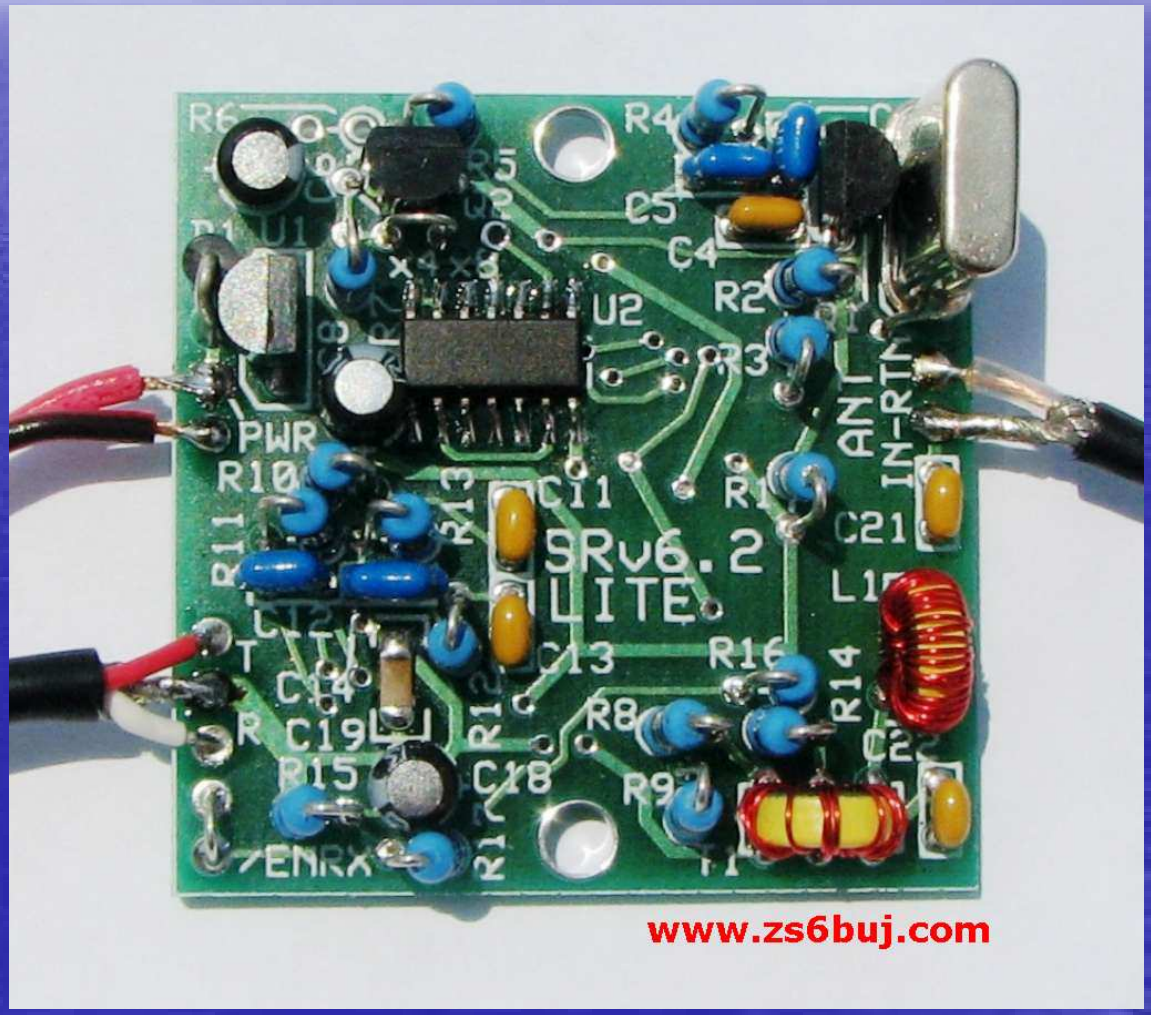


What Do You Get?

- You get a good DX receiver for 40m
- With proper (free) software, you can receive AM, DSB, USB, LSB, CW, FM, and even digital modes like PSK31, RTTY, etc
- Cost is $15 plus some time!

- For the more advanced-
  - The Softrock 40 kit is limited to the 40m band- however, the techniques can be extended to all bands with suitable BP filters and local oscillators (talk to Glen and John)
  - Transmitters and transceivers can also be built using SDR techniques

The Looks of SoftRock



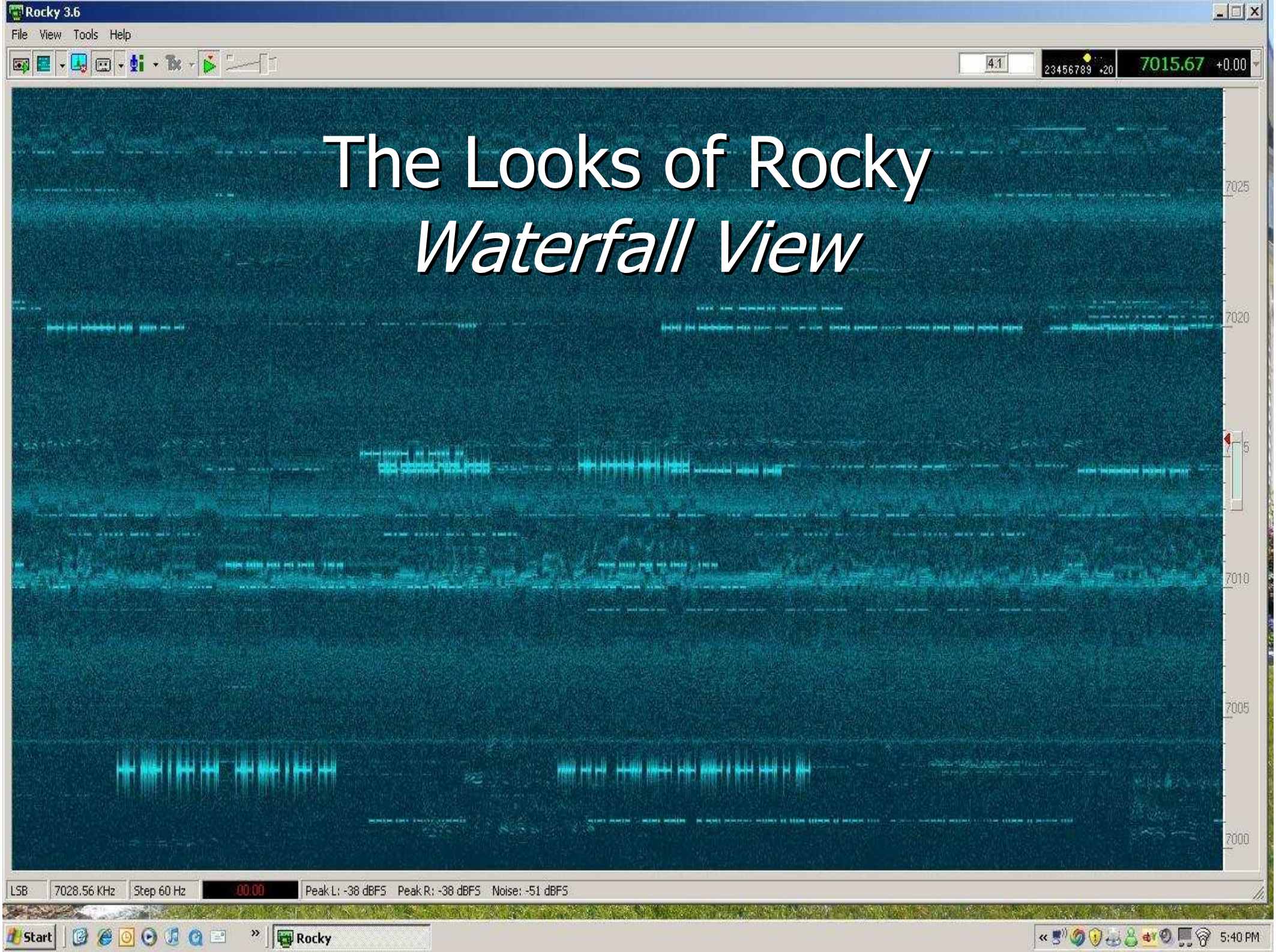
The Sounds of SoftRock…

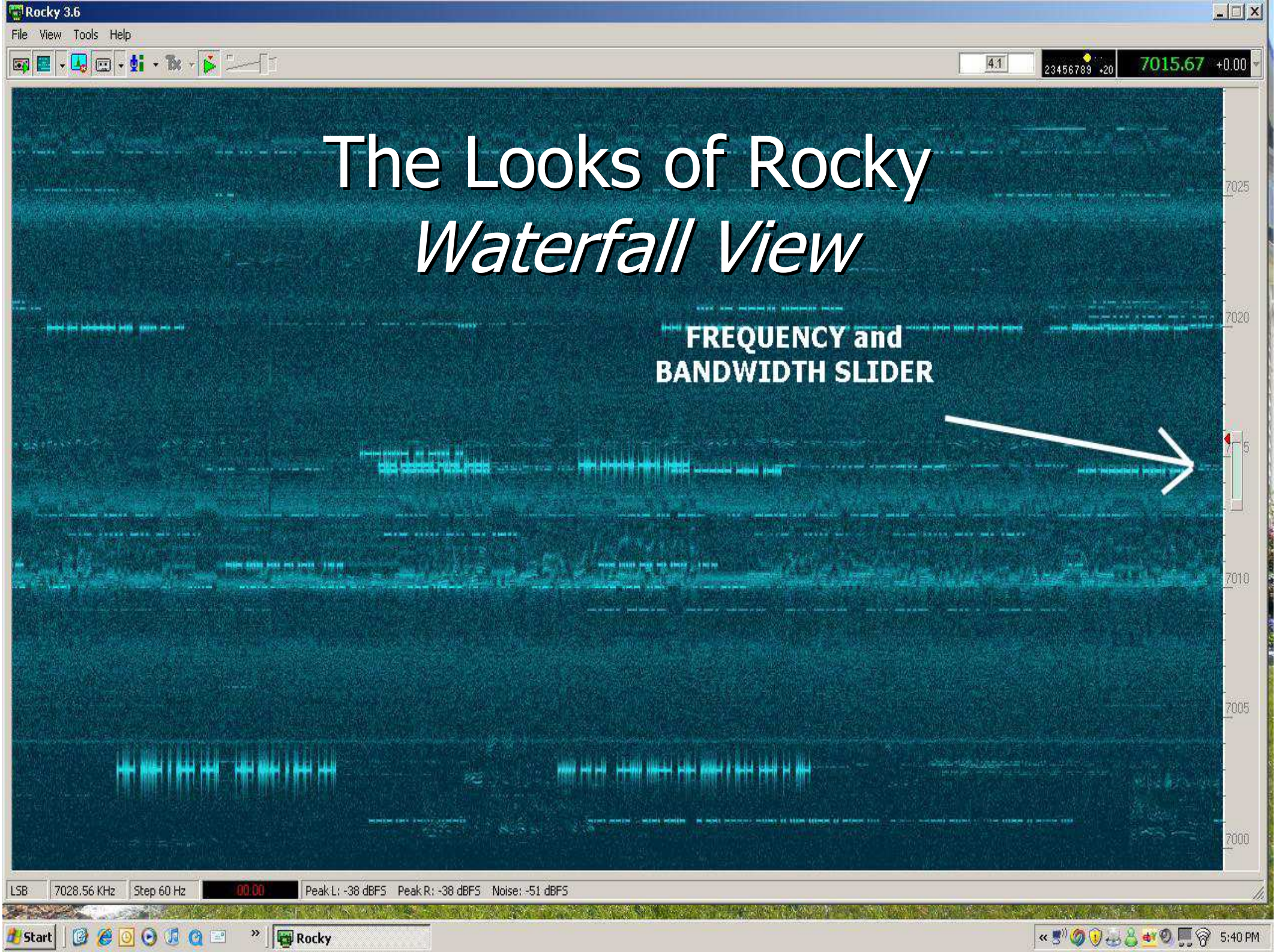
SoftRock sounds just like your radio

Audio Samples recorded from the "Rocky" program- one of many free SDR software packages

1. 40m ARRL CW Practice W1AW
2. 40m Phone LSB Woodpeckers Net
3. 40m CW KP2/K3VA - U.S. Virgin Islands
4. 40m The Soothing Sounds of PSK31

these were sample files played during the presentation- similar files can be found on the web


Rocky 3.6
File View Tools Help
7015.67 +0.00
The Looks of Rocky
Waterfall View
7025
7020
7010
7005
7000
LSB
7028.56 KHz
Step 60 Hz
Peak L: -38 dBFS Peak R: -38 dBFS Noise: -51 dBFS
Start
Rocky
5:40 PM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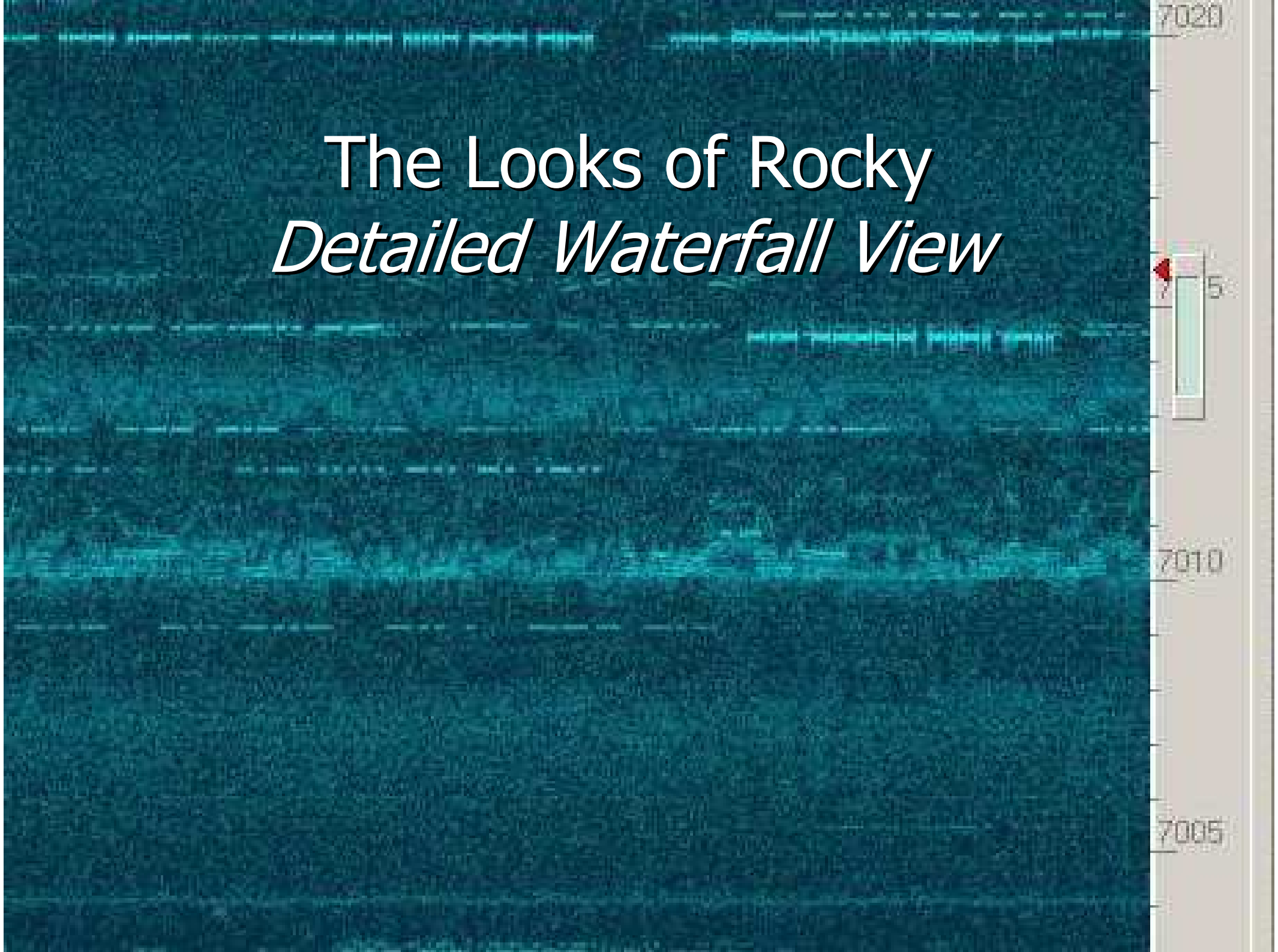
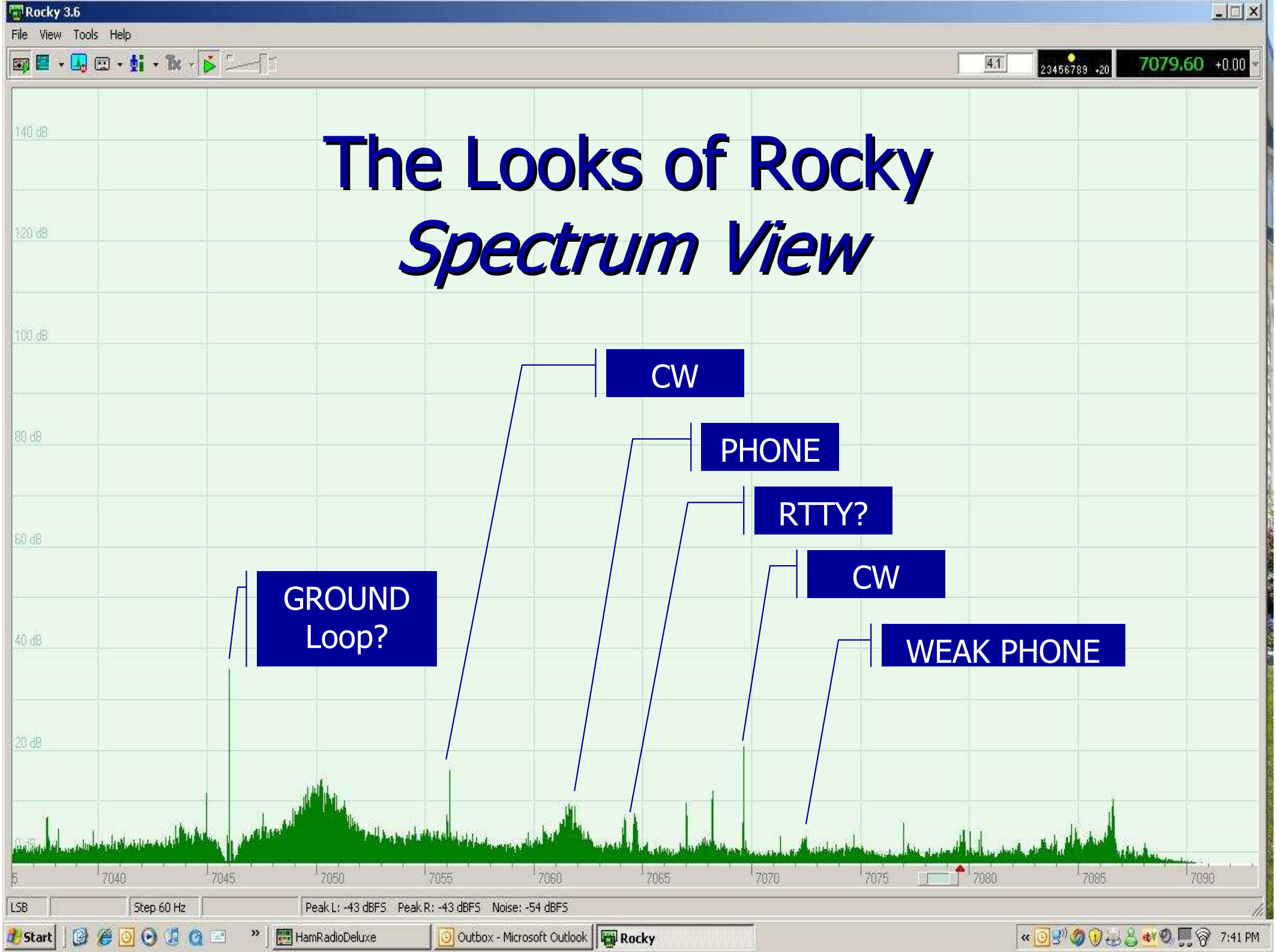
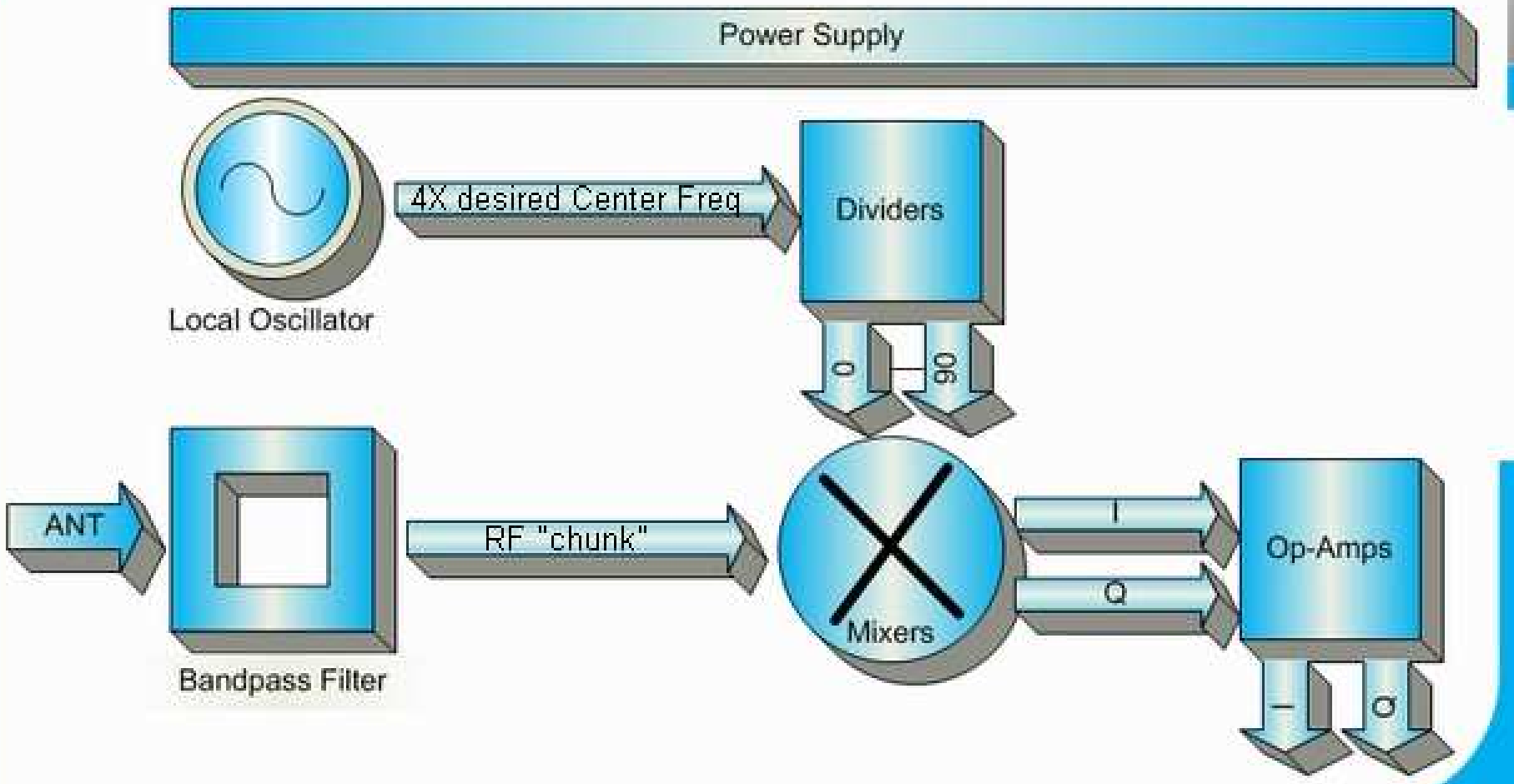


The Looks of Rocky
Detailed Waterfall View


Rocky 3.6
File View Tools Help
7079.60 +0.00
140 dB
120 dB
100 dB
80 dB
60 dB
40 dB
20 dB
The Looks of Rocky
Spectrum View
CW
PHONE
RTTY?
CW
WEAK PHONE
GROUND Loop?
7040
7045
7050
7055
7060
7065
7070
7075
7080
7085
7090
LSB
Step 60 Hz
Peak L: -43 dBFS Peak R: -43 dBFS Noise: -54 dBFS
Start
HamRadioDeluxe
Outbox - Microsoft Outlook
Rocky
7:41 PM

How the Softrock Receiver Works

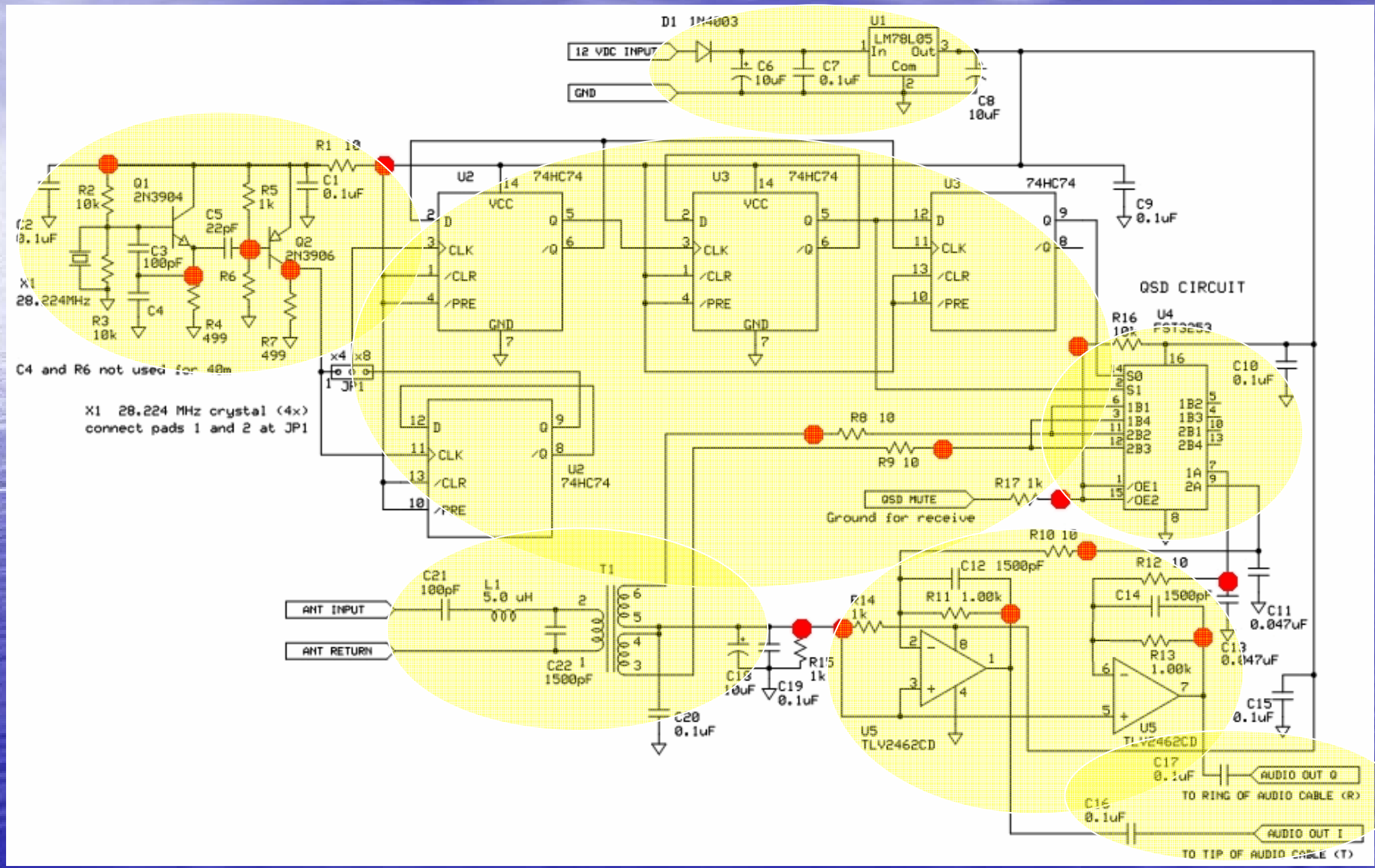
Block Diagram



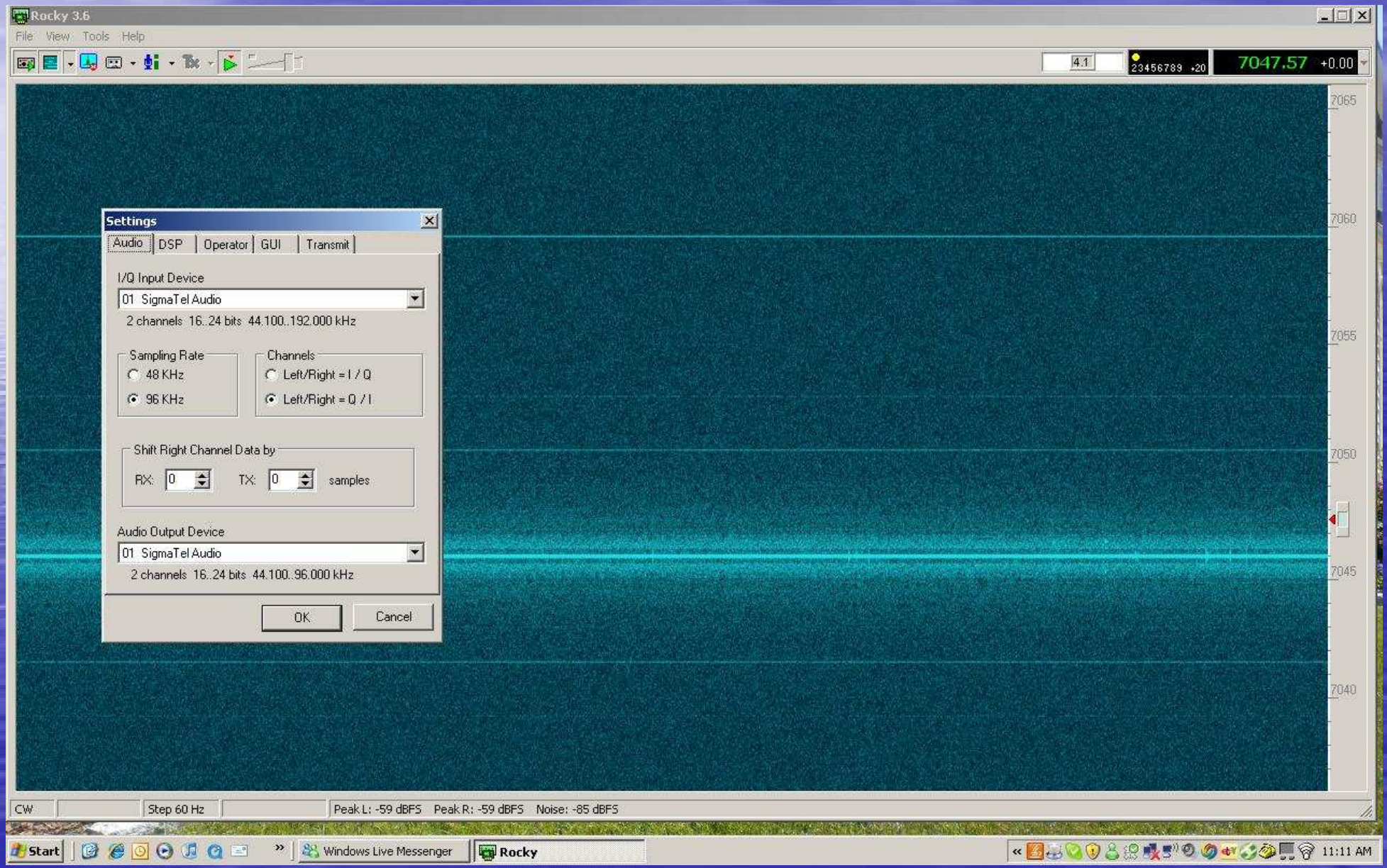
What's All this I&Q Stuff

- I&Q is "in phase" and "quadrature"
- Any signal can be represented by these two vector components- I=X, Q=Y
- AM demodulation is simple- A = SQRT(I^2+Q^2)
- Phase can be calculated by looking at the angle between them= atan(Q/I) <tan =opposite/adjacent>
- SSB is done by manipulating signals with arithmetic and getting sums (USB) or differences (LSB) to cancel out
- The SDR Software handles all this magic- it is difficult to get a firm grasp on it without some very diligent study.
- The good news is that you don't need to understand all this to enjoy SDR. The software has been created by some very smart and hard working people who give it away!
- There are many references on the web for the curious- look at "SDR for the Masses" in QST for a good intro

Schematic of Softrock 40



Rocky Software is a good simple starting point- download from www.DXAtlas.com

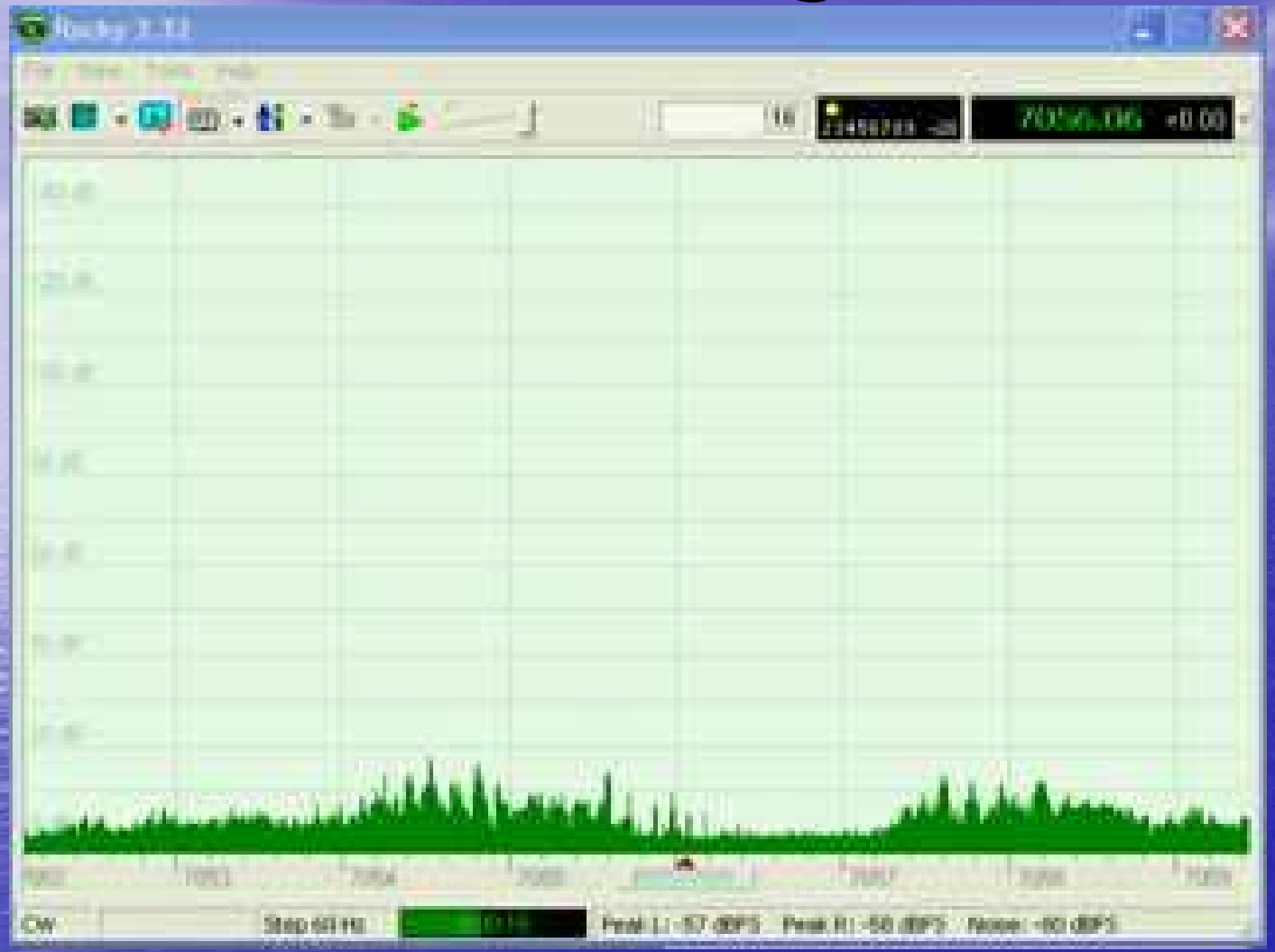


Software Operation- Rocky

- Rocky Is A GUI- Windows point and click-
- Some Software is Virtual Radio Based
- Tuning Rocky
  - Zoom spectrum or waterfall with top zoom control
  - Selecting a Signal is done by clicking on it
  - Adjust BW by Grabbing Slider
  - You can use a Griffin Knob to tune >

- Options in Rocky
  - Menus and Pickboxes at Top- Multiband, Mode, etc
  - AGC and some functions have special sliders
  - There is also a ini file to save your setup

SoftRock Running with Rocky



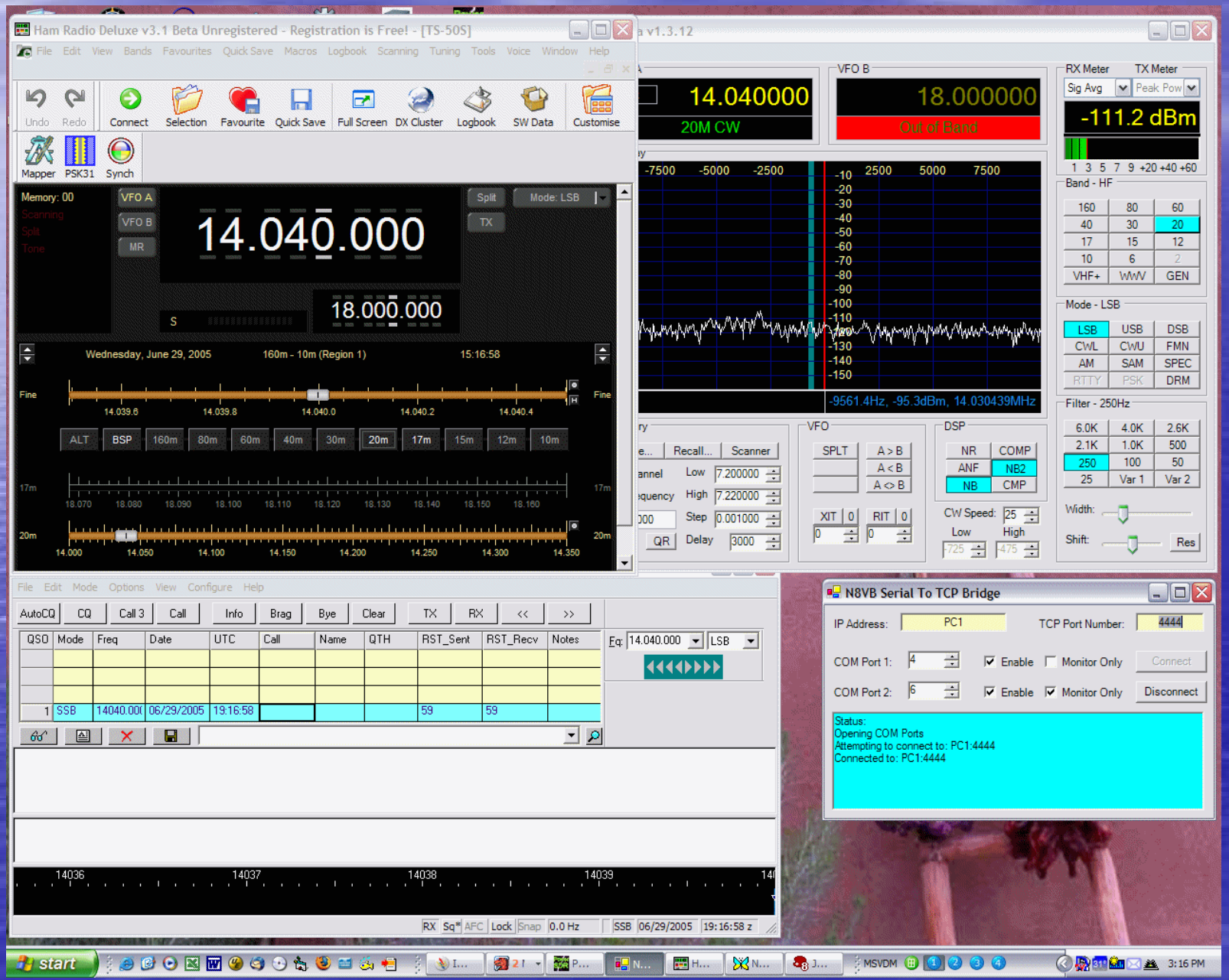
this file was a video demo for the RARS presentation but can be downloaded from the web

Other SDR Software - FREE

- PowerSDR – I/Q is Powerful/Flexible
- Multiband RxTx with individual band settings
  - Frequency control of Si570 DDS Local Osciallator
  - Bandpass filter selection for Multiband
  - Flexible PTT Control for Radio
  - CW Feature and Keyer Function
  - And Much More
- PowerSDR is a bit daunting to get running for a first time user but is amazing once you understand it

SDR Software Alternatives- FREE

- Flex RadioPowerSDR- Hybrid Virtual/GUI Radio

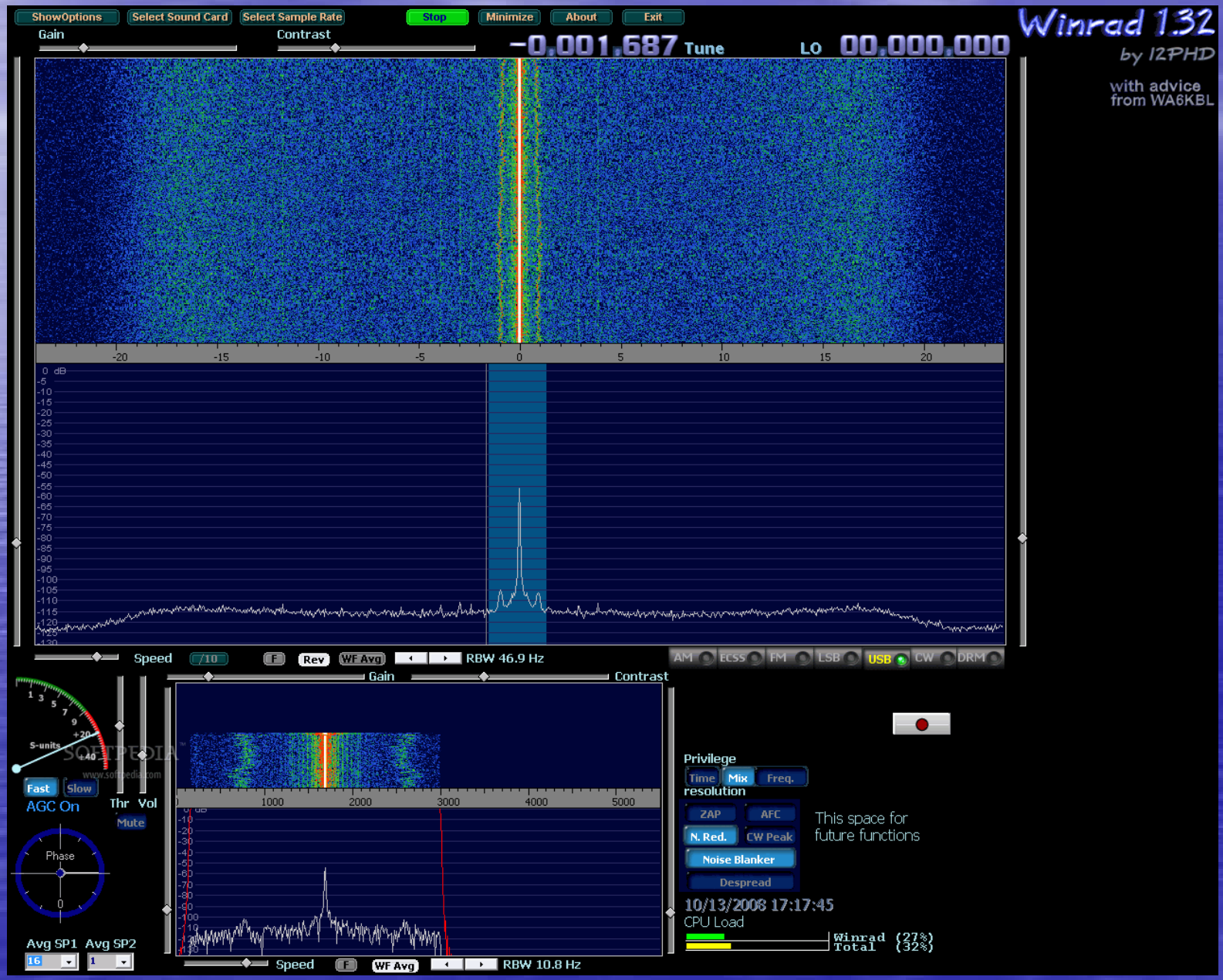


More SDR Software Alternatives- FREE

SDRadio- Virtual Radio Interface with Click Tune

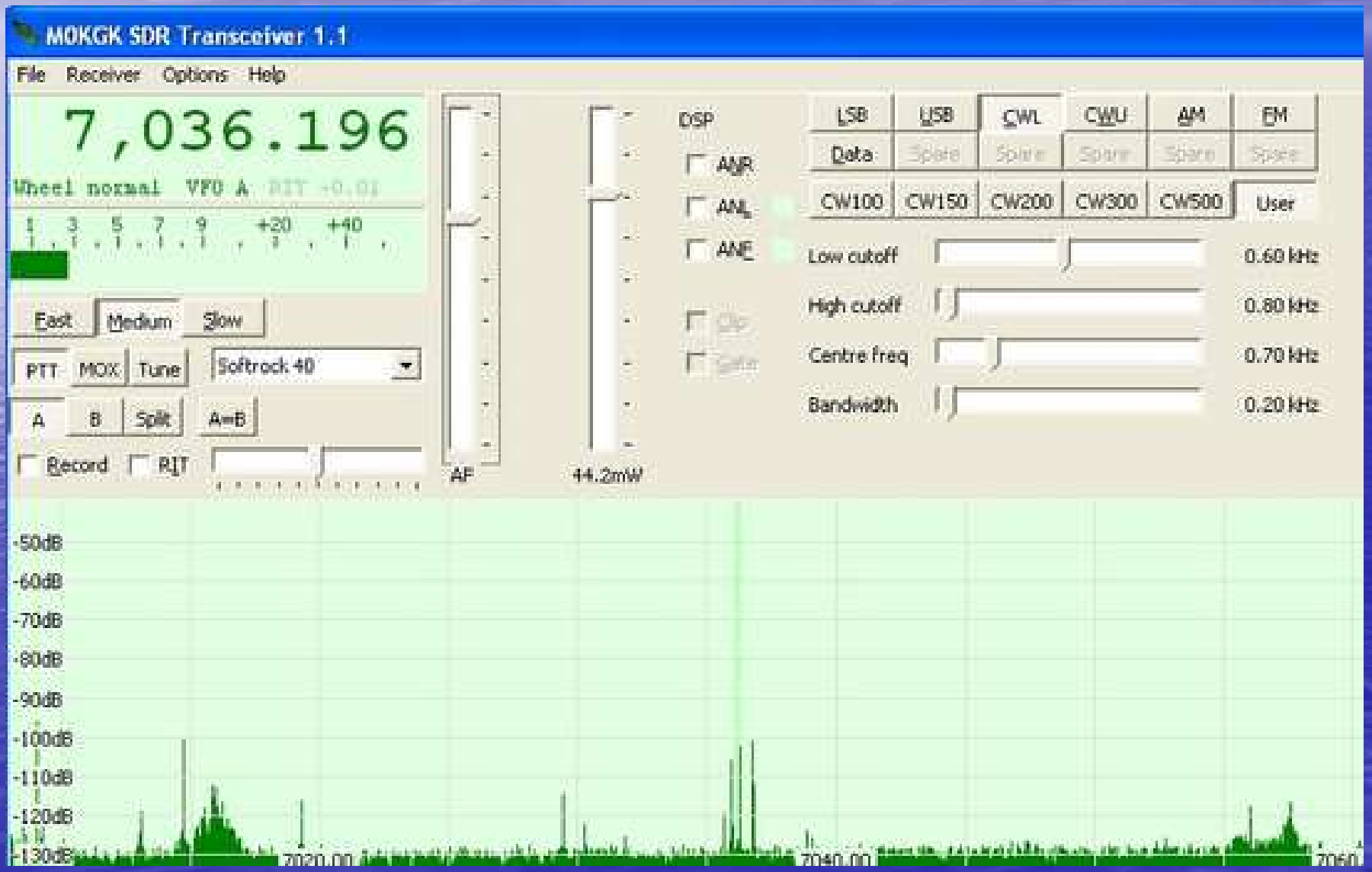
Even More SDR Software Alternatives- FREE

Winrad – I2PHD ("LINRAD" supports Linux)



Yet Even More SDR Software Alternatives-

KGKSDR by MOKGK- Medium Weight Program with Most Features of Power SDR

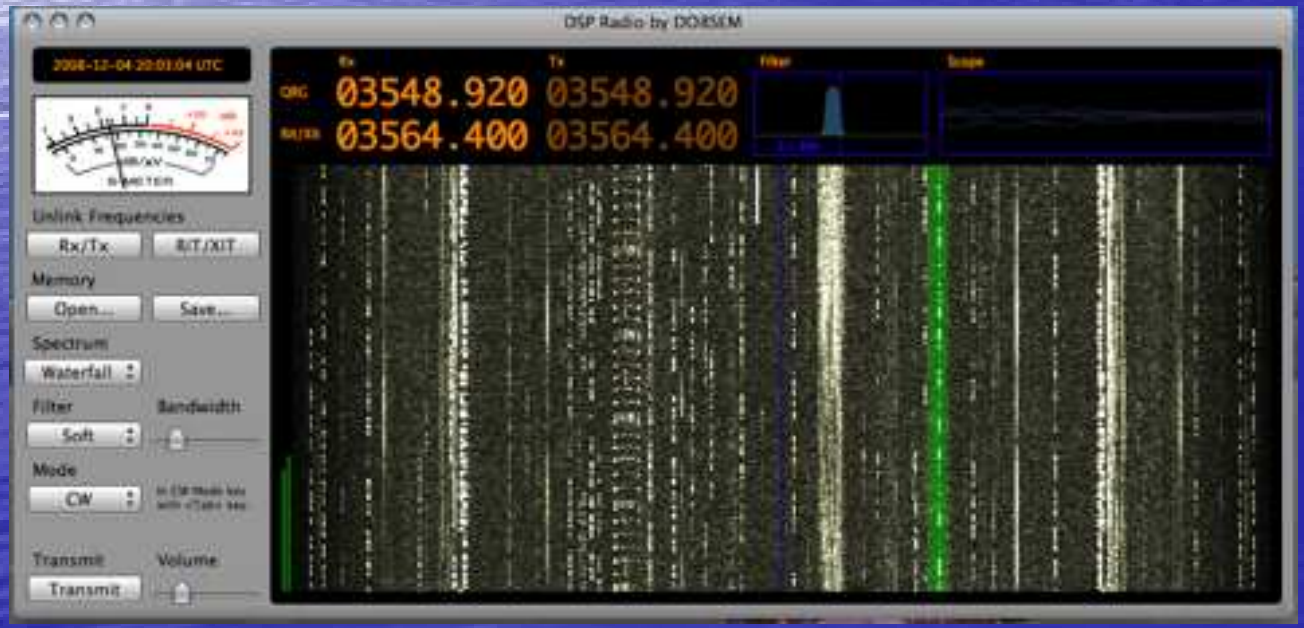


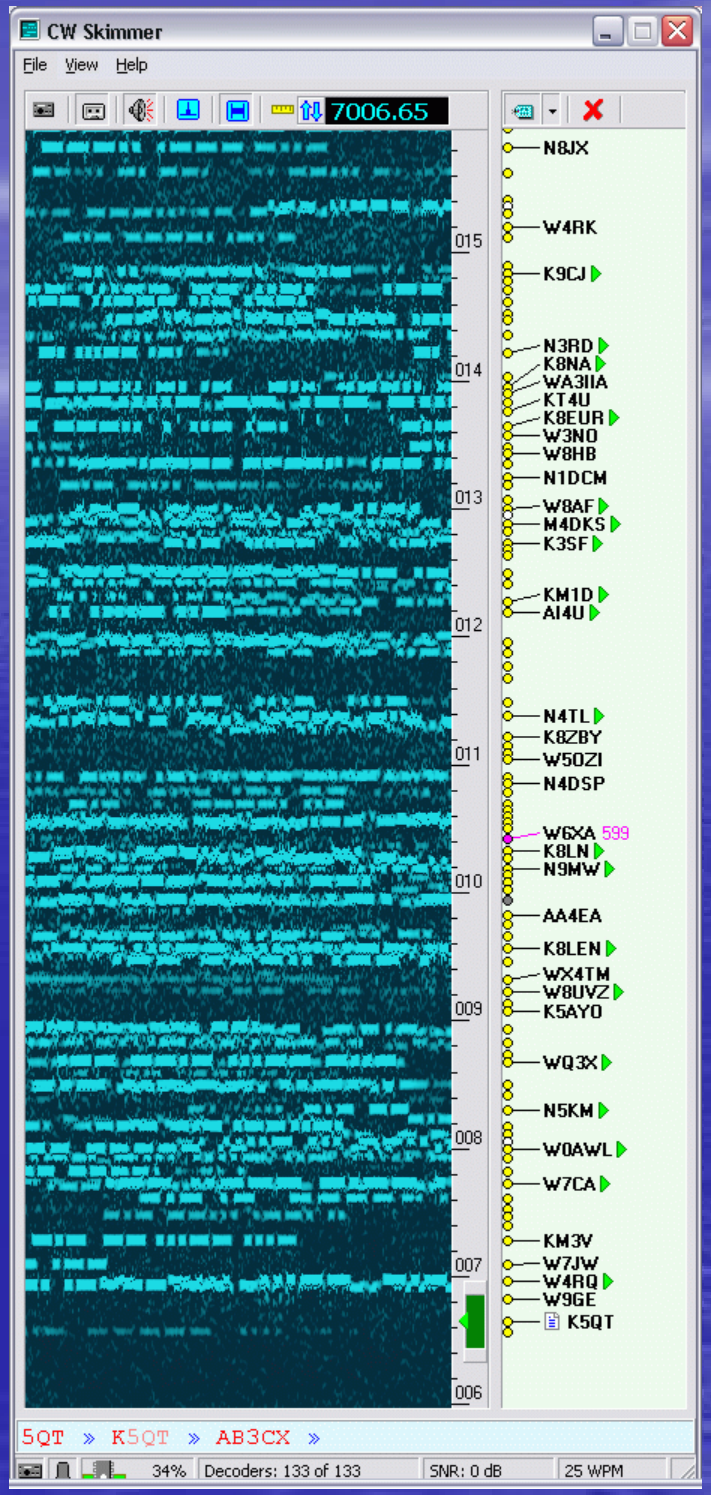
But Wait!- There are even more SDR Software Alternatives!

CWSkimmer

Yes!- there are also SDR MAC OS Options

Check out DO8SEM's MacSDR

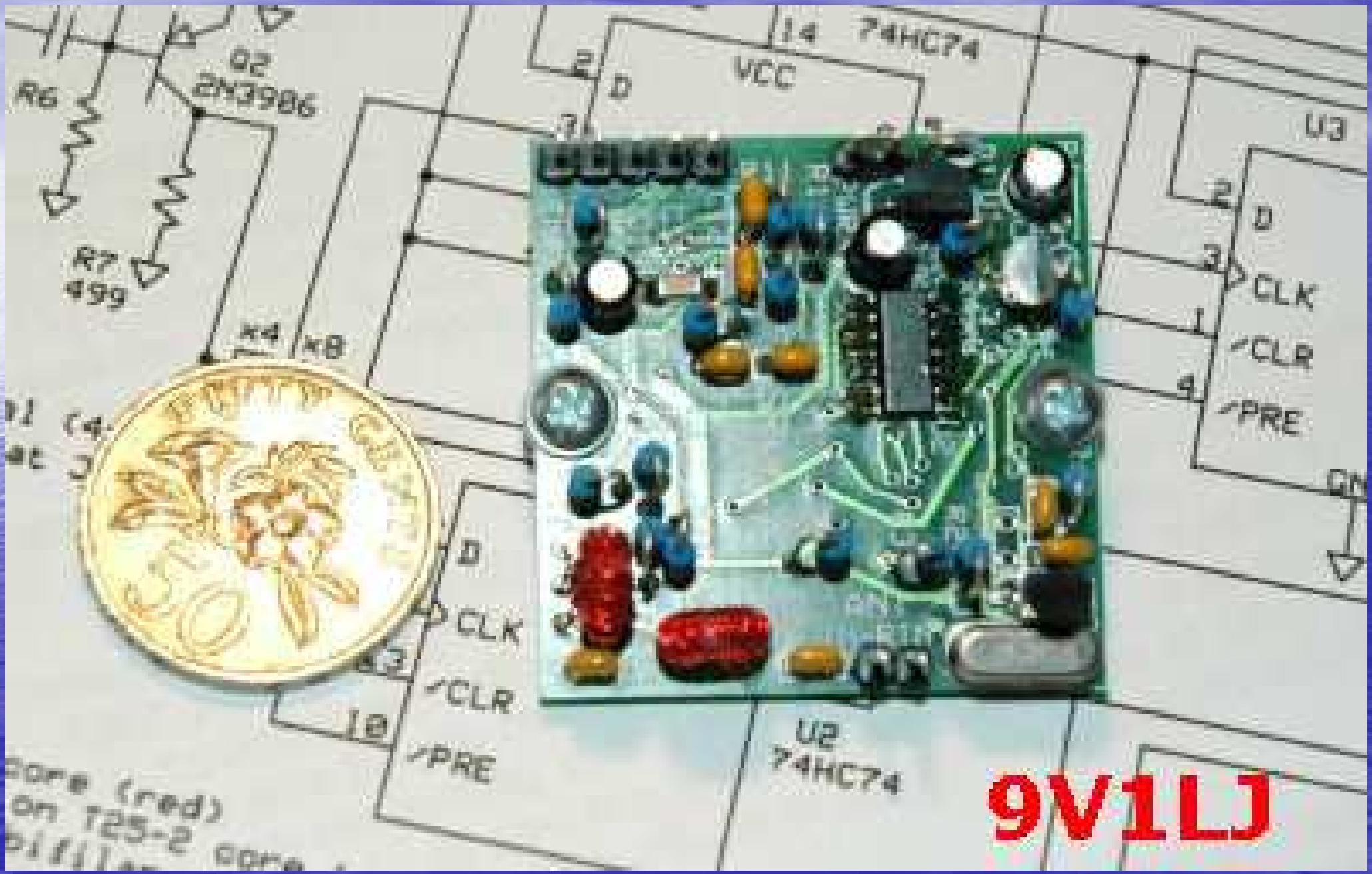




OK- I'm Sold…
How Do I Get Started

- Buy a SoftRock SR Lite v6.2 Kit
  - From RARS - PayPal $15 to K1GW@ARRL.NET
  - From KB9YIG $10 + shipping - see Yahoo Softrock40 Group
- Check the web for Great Resources- Choose Software
  - Yahoo Groups- Softrock40
  - Just Google "SDR" or Softrock
- Assemble Kit and Configure Your Software/System
- Get on the Air and Experiment- Hardware, Software
- We will help you succeed at this
  - We can help with assembly, debugging or software setup
  - We can arrive early for RARS meetings or you can just call us
    - Glen 557-0626
    - John 303-5733
    - Chris 773-6186

Building the Kit- Surface Mount- Oh No?!



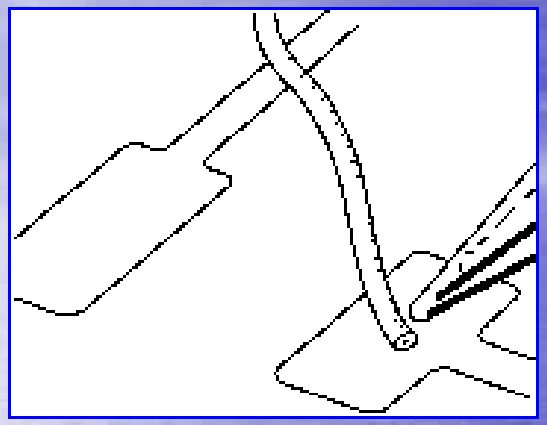
Why Surface Mount?

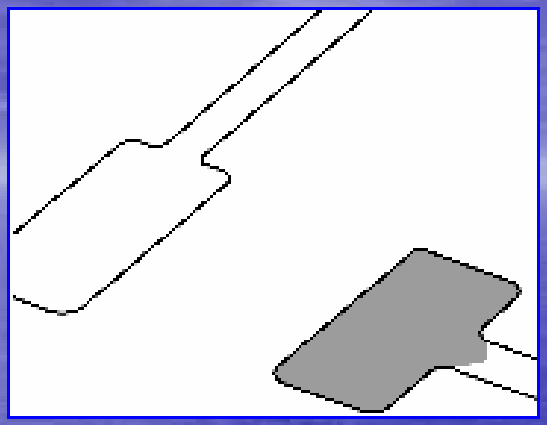
- Advantages
  - Much smaller components- much denser end equipment
  - Higher Pin/Connection Counts per Component- several hundred for uBGA
  - Less Hole Drilling in Abrasive Boards
  - Simpler and faster automated assembly- 50K parts/hour!
  - Components can be placed on both sides of the board.
  - Lower resistance and inductance- parasitics improved
  - Smaller Current Loops and Shorter Traces Improve EMI and RF Performance
  - Less mass and better mechanicals for shake and vibration conditions.
  - Generally lower cost less than through-hole parts.
- Main disadvantages
  - SMDs can't be used with breadboards easily. They require an adapter of some kind
  - Manual prototype assembly or component-level repair is more difficult
  - The manufacturing processes for SMT are more sophisticated than through-hole boards, raising the initial cost and time of setting up for production.
- Conclusion
  - There are numerous advantages to SMT assembly and few Cons
  - Its not cost effective to make through hole IC's for a few experimenters
  - SMT Assembly is here to stay- embrace it and learn to work with it

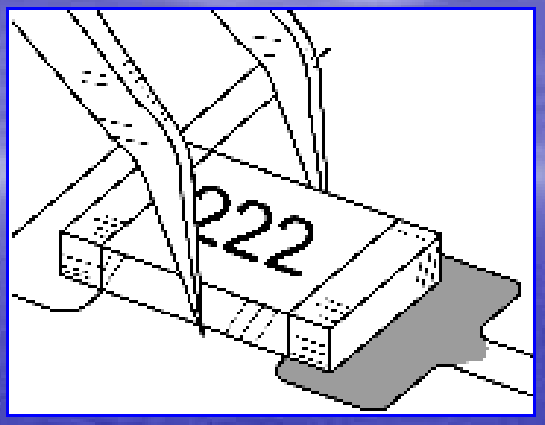
Building Tips for First Time SMT'ers

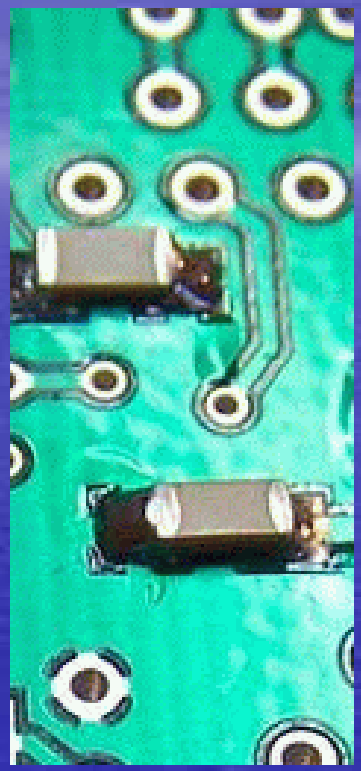
- You Will Need Good Light, a small iron, small solder, solder wick, liquid solder flux, magnification, a small vise, some small hand tools and tweezers- all is available at Radio Shack for basics
- Forget all the SMT Hot Plate Stuff you've Seen on the Web
- Flux and Solder Wick are two Secrets
- The 2006+ ARRL Handbook has some good illustrated instructions on SMT passive assembly

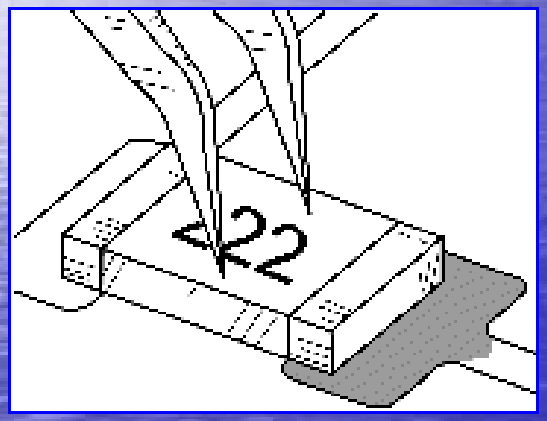
Soldering SMT Passives (0805)

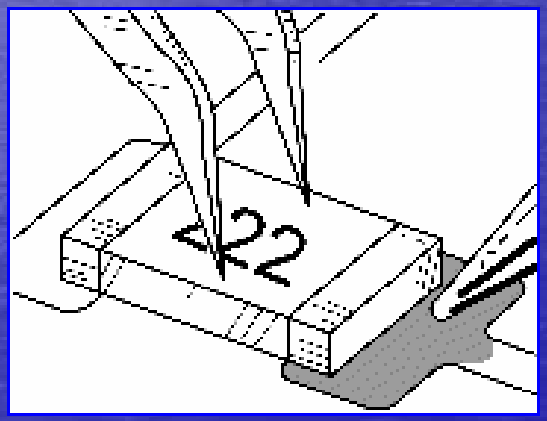


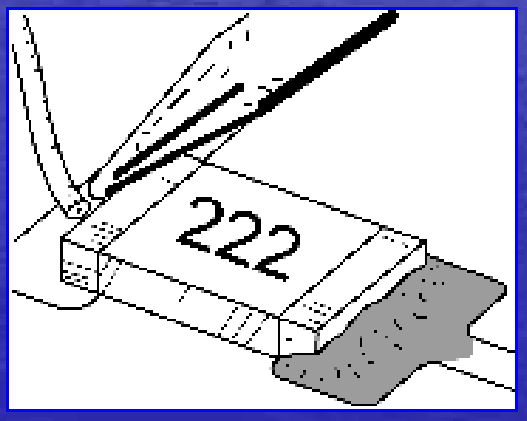


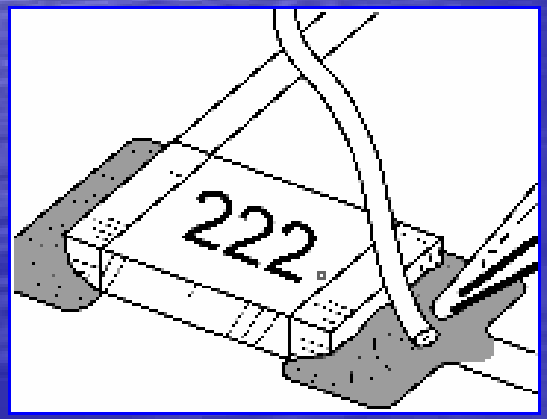


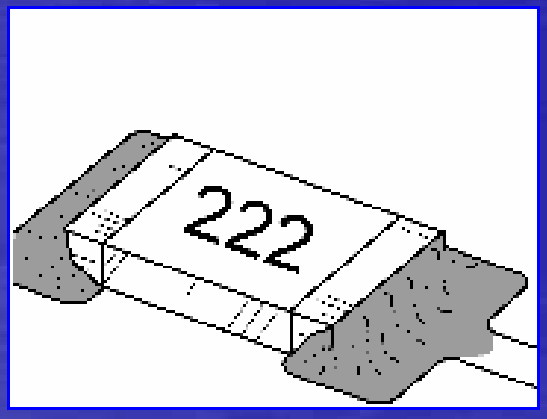


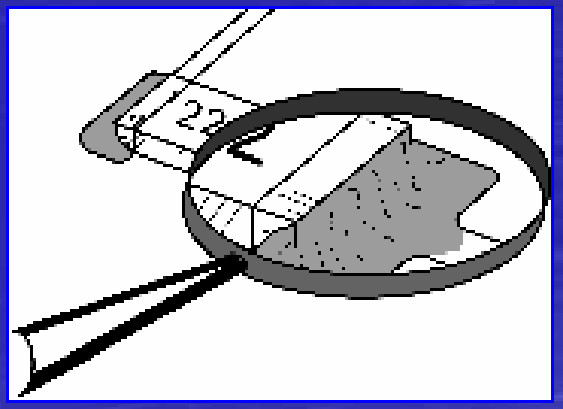












Soldering Demo Video

This file can be downloaded from Curious Inventor website

SoftRock Assembly Tips

- Keep it Simple- Take it slow and prepare
- Near Heathkit Style Instructions on the Web
  - Google WB5RVZ Softrock
  - groups.yahoo.com/group/softrock40/files/
- The SoftRock kit is very forgiving- the resistors are installed on end. SMT only for IC's and Caps
- Two little toroids- Stripping enamel wire is the biggest single assembly error that we've seen
- Stabilize the I/O cables immediately, use strain reliefs, avoid going mad!
- Power things up systematically with a current limited source- batteries can fry things.
- Get Help When Confused- Glen, John or the Yahoo Group are All here to help.

Minimum Required Bench/Lab

A Very Well Equipped Lab

Assembly Equipment for SMT

Go Forth and Conquer!

- This presentation has just scratched the surface of this exciting segment of ham experimenting- you can take it anywhere….
  - Transceivers
  - Multiband- Input Filters and DDS, PLL VFO's
  - Embedded DSP- No PC
  - Sound Card Experimentation- 24 Bit/192KHz
  - Software Experimentation- Write your own…
- SDR On the Air night – May or June?
- Get involved and Have Fun!