Introduction to Software Defined Radio (SDR) - A Hands-on Course

Class 3: Exploring SDR with the RTL-SDR, Part 1

September 27, 2017

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Presented by:

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This Week's Agenda

9/25 Intro to SDR

9/26 RF and Radio Basics

9/27 Exploring SDR with the RTL-SDR, Part 1

9/28 Exploring SDR with the RTL-SDR, Part 2

9/29 Commercial SDR Designs

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Our Kit

What is the RTL-SDR?

RTL-SDR is a very cheap software defined radio that uses a DVB-T TV tuner dongle based on the RTL2832U chipset. With the combined efforts of Antti Palosaari, Eric Fry and Osmocom it was found that the signal I/Q data could be accessed directly, which allowed the DVB-T TV tuner to be converted into a wideband software defined radio via a new software driver.

Essentially, this means that a cheap $20 TV tuner USB dongle with the RTL2832U chip can be used as a computer based radio scanner. This sort of scanner capability would have cost hundreds or even thousands of dollars just a few years ago. The RTL-SDR is also often referred to as RTL2832U, DVB-T SDR, RTL dongle or the “$20 Software Defined Radio”.

-from https://www.rtl-sdr.com/

Adafruit 1497 Kit

Includes the “nano” package RTL2832U along with the R820T2 tuner, giving us approximately a 24-1730 Mhz range of tuning. We can go up or down from this range with an appropriate up or down converter.

We will not use the remote or disk today

The software that we will be using today should work with most any of the RTL2832-based dongles or adapters.

Although an inexpensive ‘hobbyist’ kit, we can use this to learn the principles used in commercial SDR development. On Friday we will look at more sophisticated hardware including transceivers.

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The Antenna

- The antenna in the kit is approximately 6” long and has a magnet in the base to attach to a ferrous surface.

- Question 1 – two parts:
  - What approximate frequency is the antenna best at?
  - How big a piece of metal should it be attached to (ideally)?

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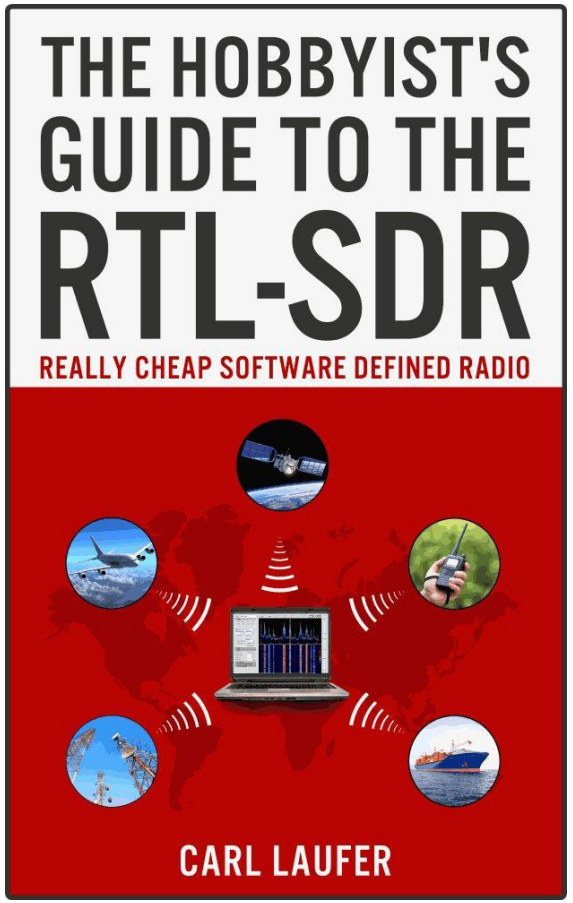
A Good Book to Have

The Hobbyist's Guide To The RTL-SDR: Really Cheap Software Defined Radio

A Guide to the RTL-SDR and Cheap Software Defined Radio by the Authors of the rtl-sdr.com Blog

http://amzn.to/2ys9qdc



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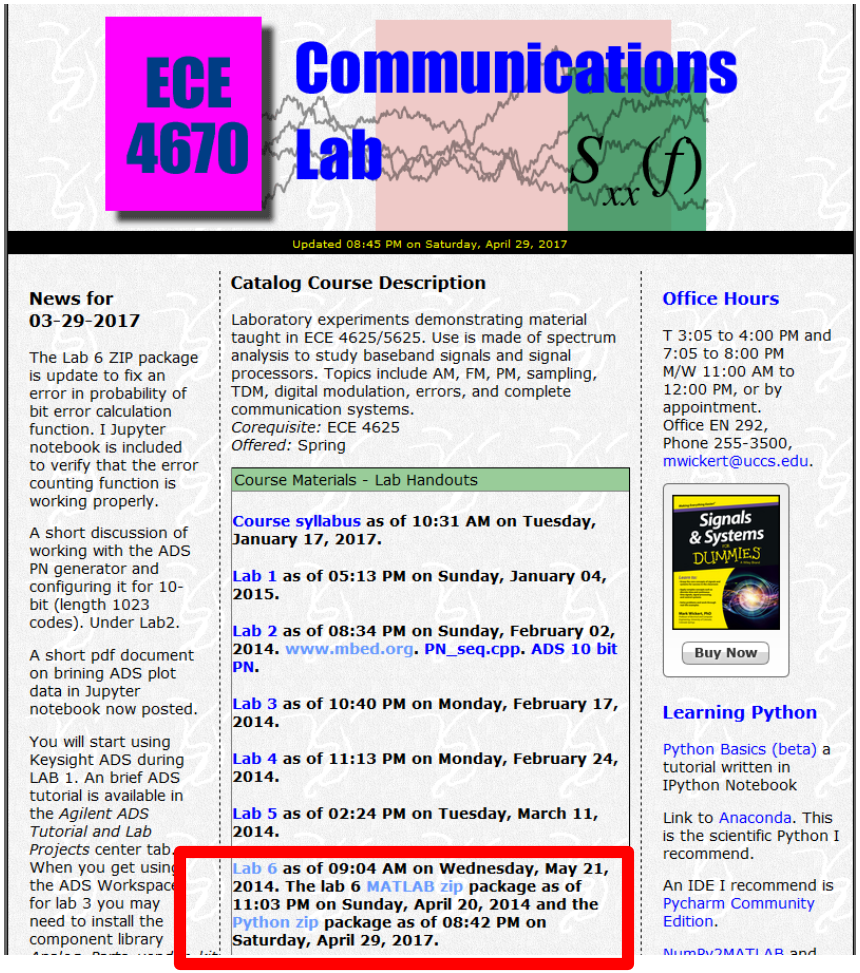
The Book

- Along with the many great examples of projects including tracking planes and boats and exploring the wavelengths, the author starts off by directing us to the website of Dr Wickert at University of Colorado College of Engineering and Applied Science, where he teaches a class based on the RTL-SDR and provides all of his notes and labs (!)

http://eas.uccs.edu/~mwickert/ece4670/



The class is taught using SDR#, Python, and MATLAB. He also provides links to his tutorials on python and Matlab.

The first thing to download from the site is the Lab 4 document and the lab zip files (one each for python and Matlab.

I found his links to the version of python and an excellent IDE to be very helpful!

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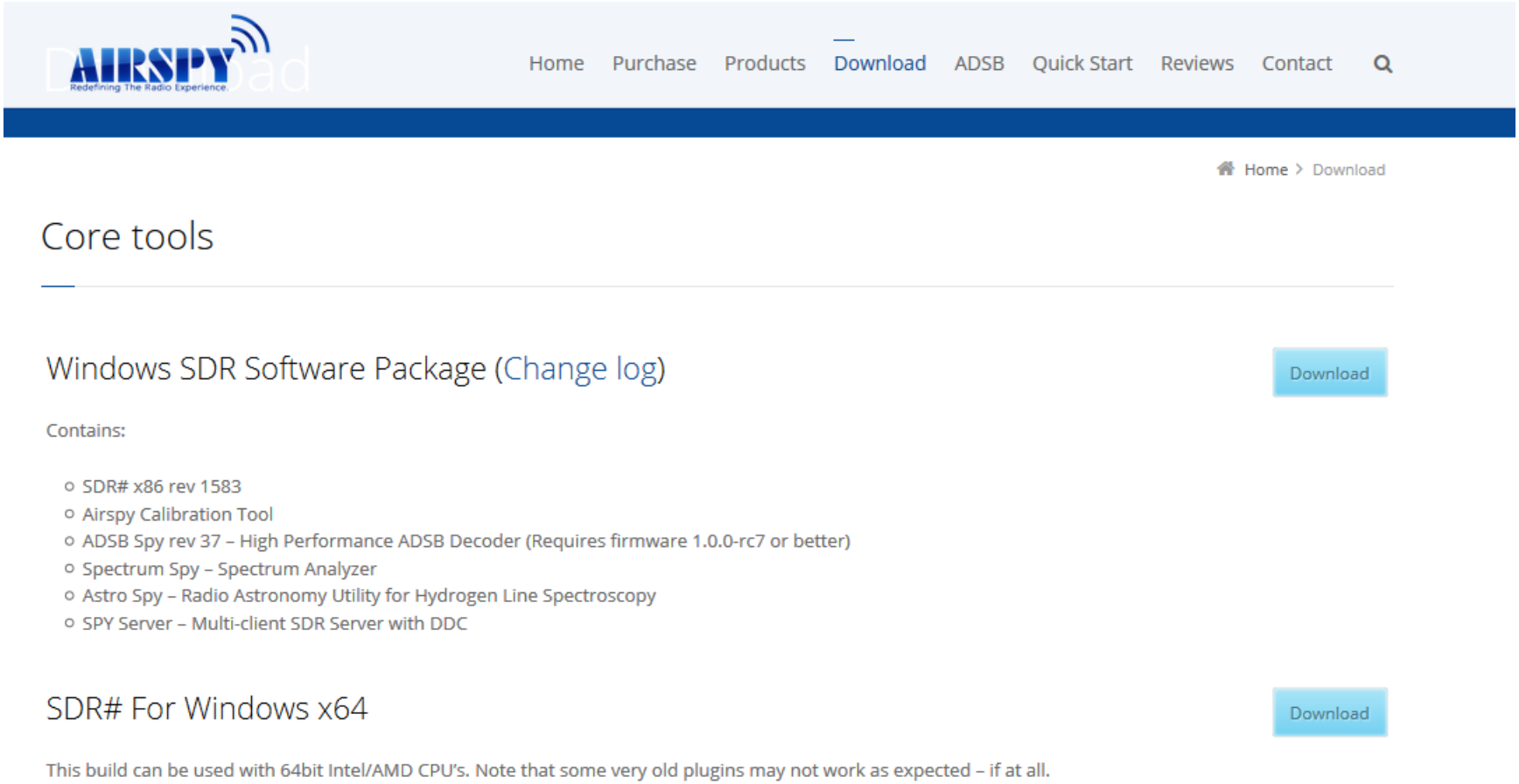
First, we want to get SDR#



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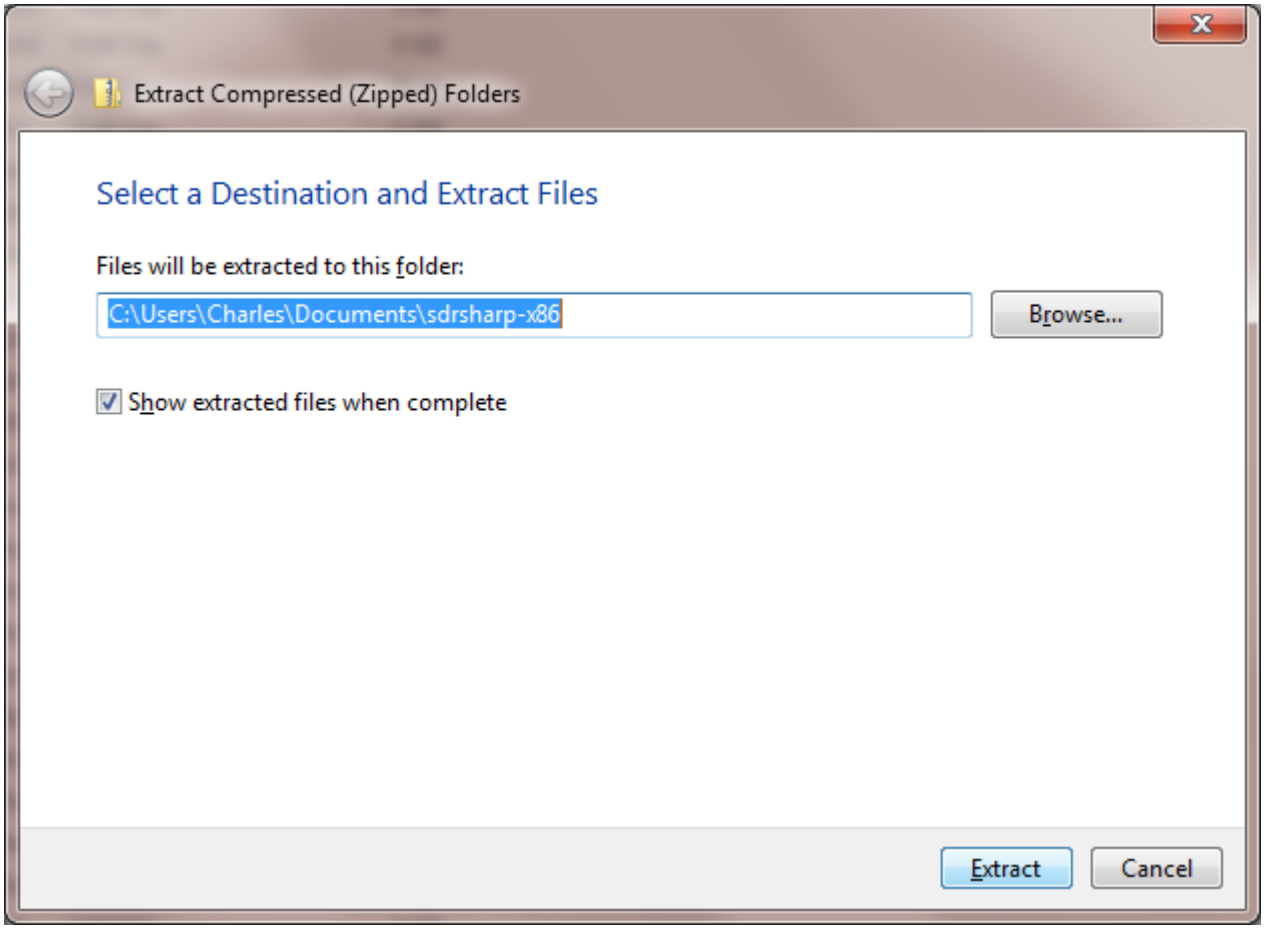
Unzip to a Handy Place



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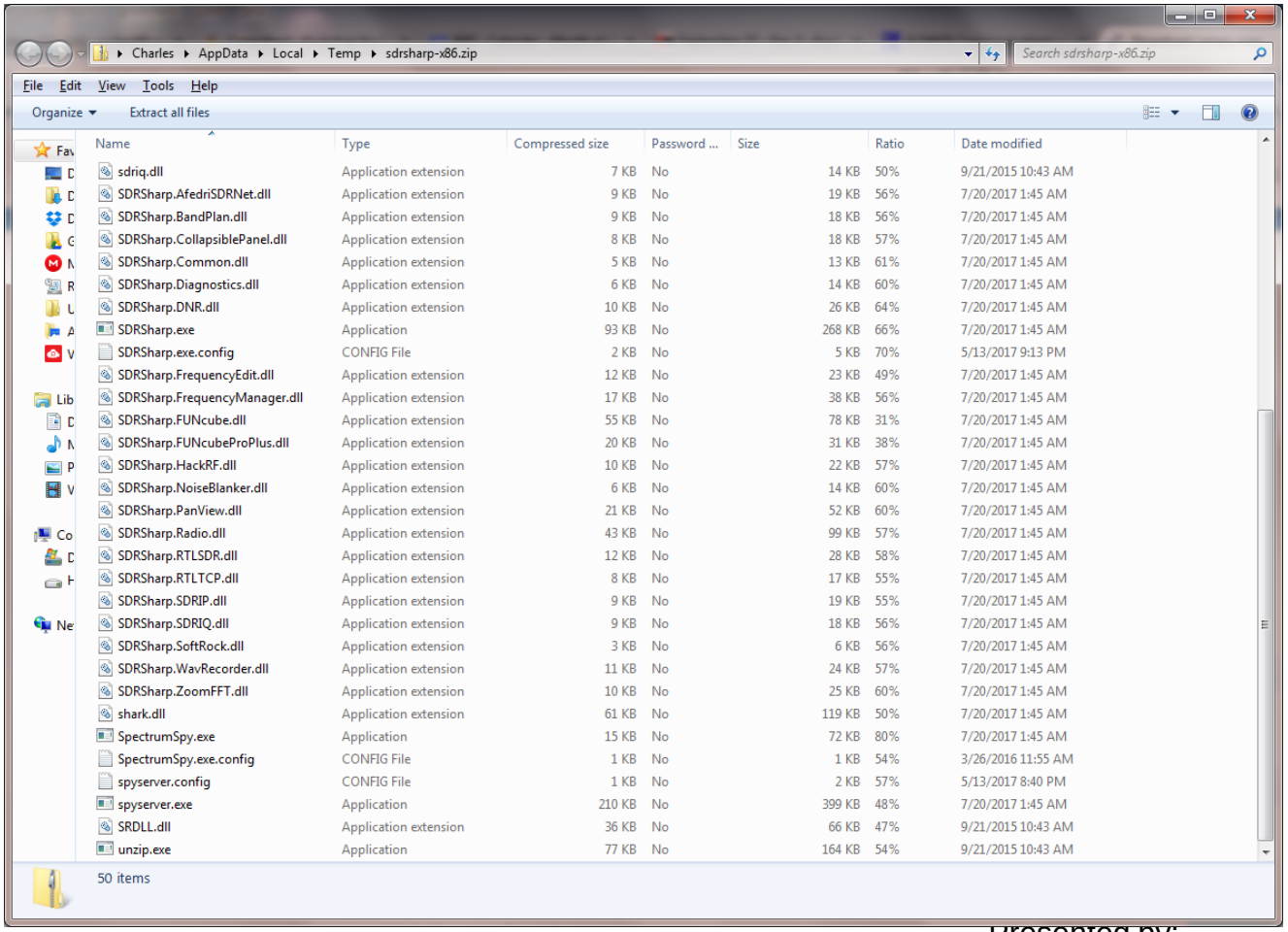
LOTS of plugins



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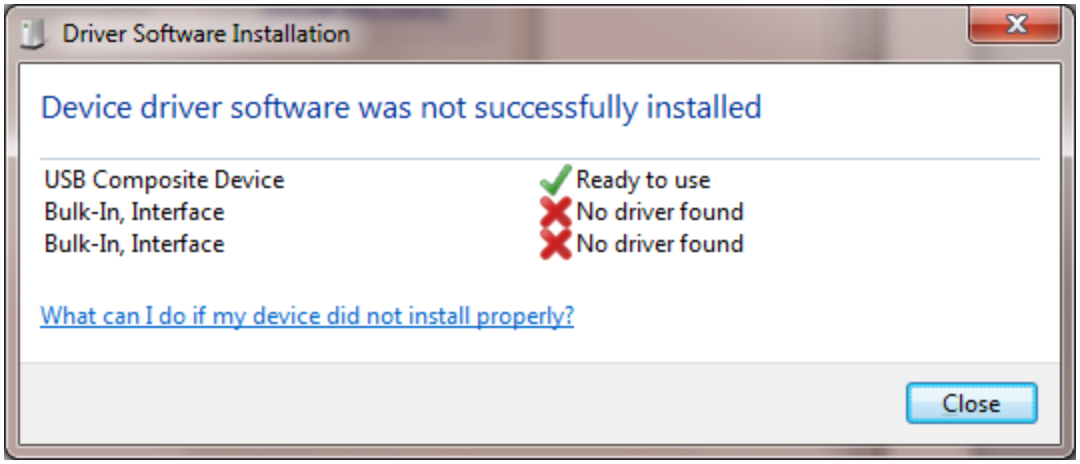
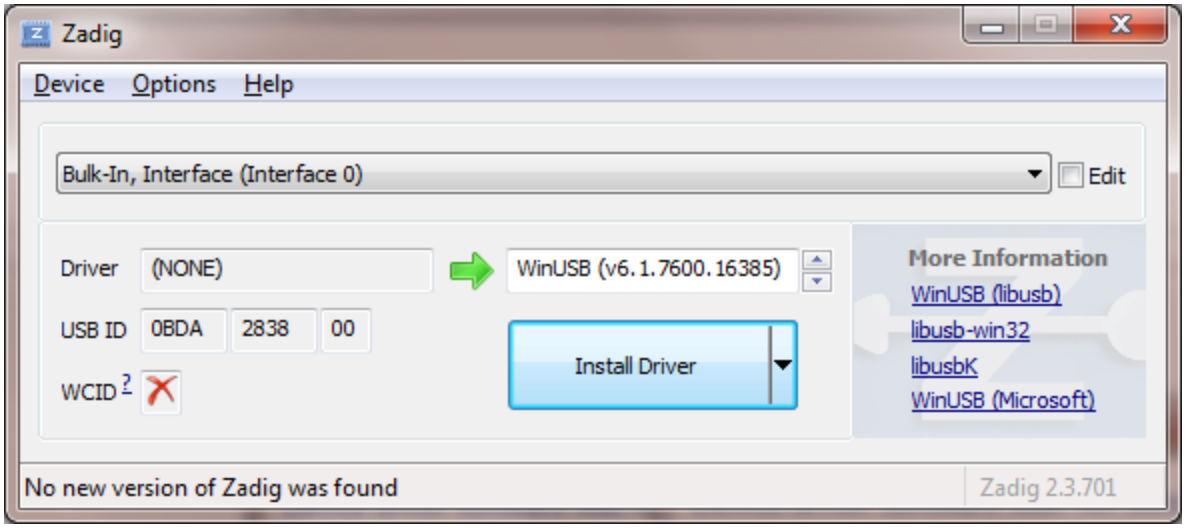
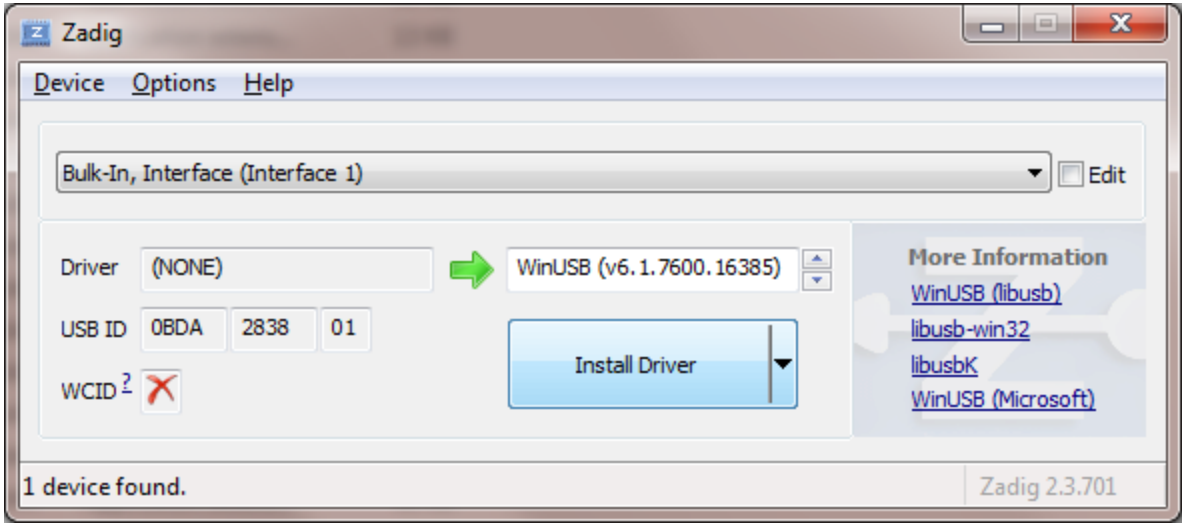
We need Drivers! Or you may have the wrong drivers…

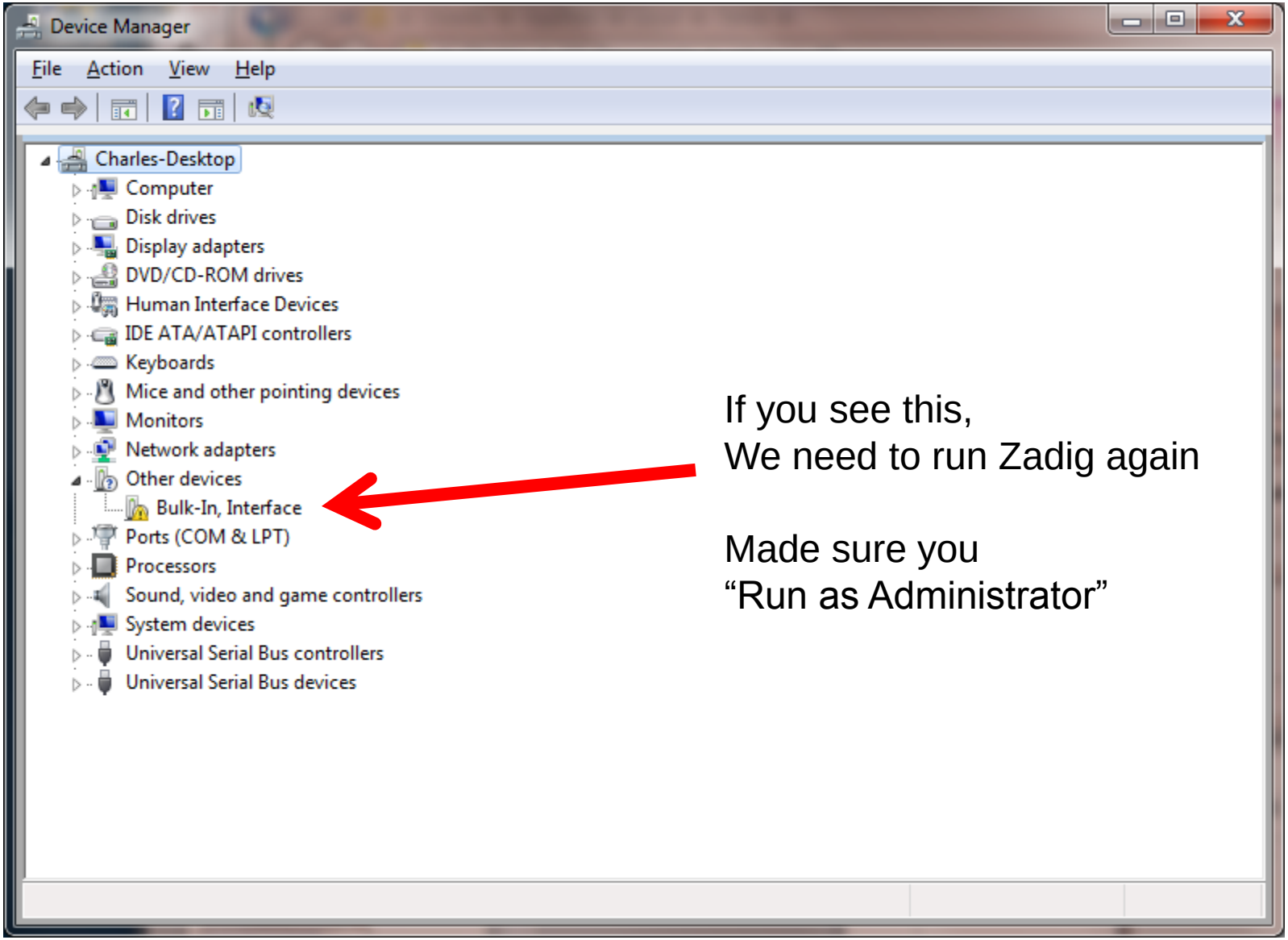


Question 2 – Why might we need to replace a driver?

Run Zadig.exe as Administrator







If you see this,
We need to run Zadig again

Made sure you
"Run as Administrator"

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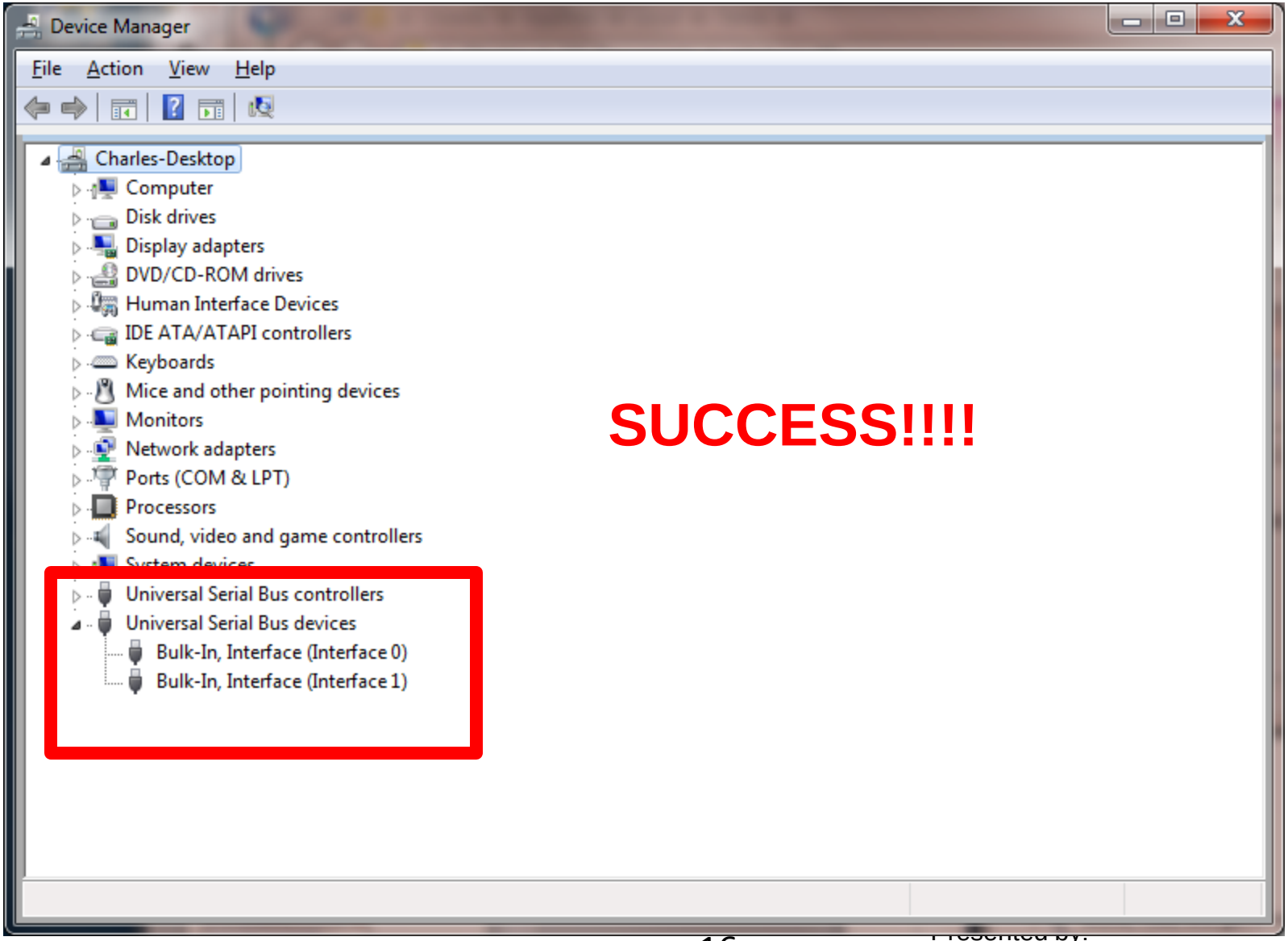

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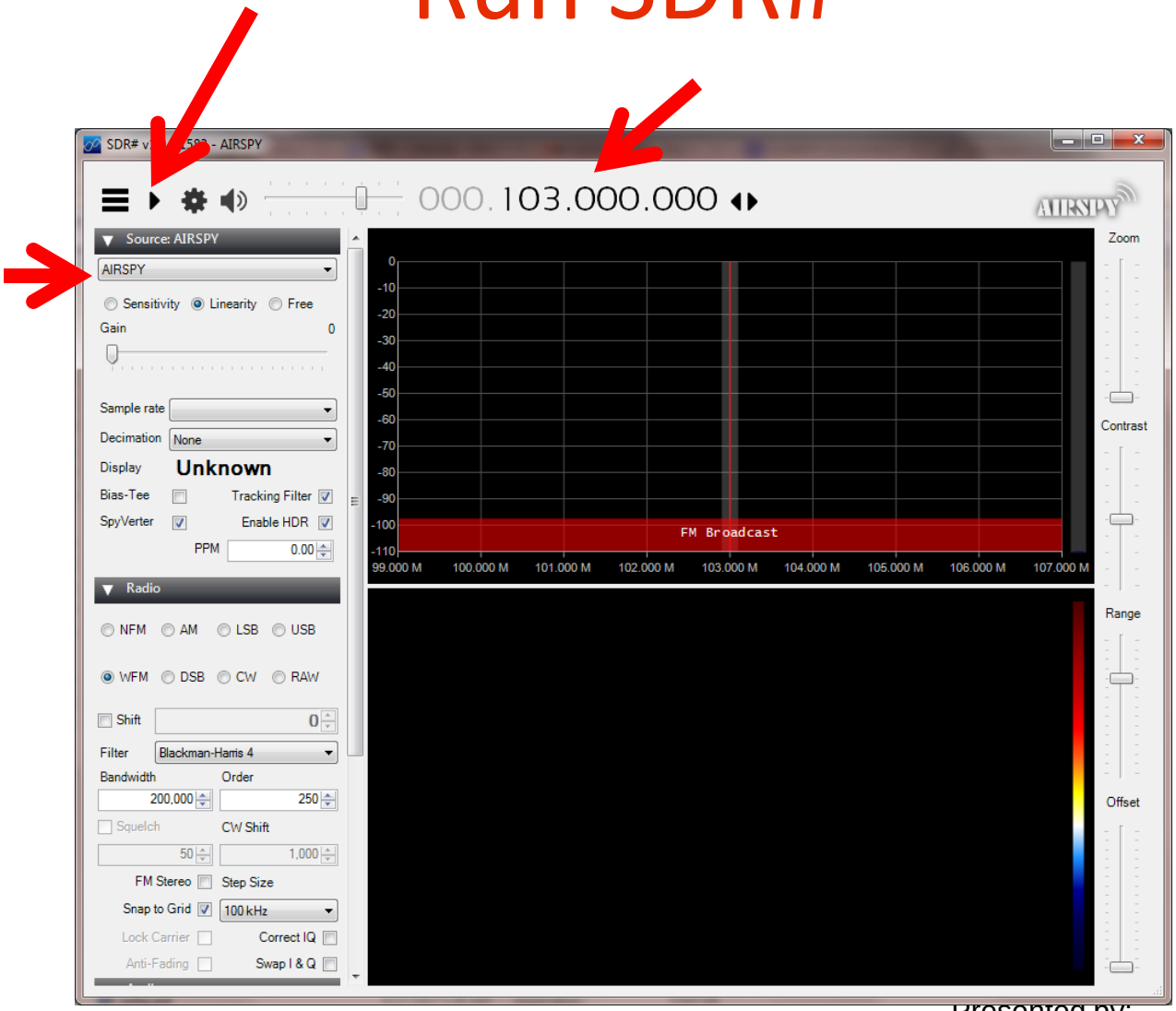
Run SDR#



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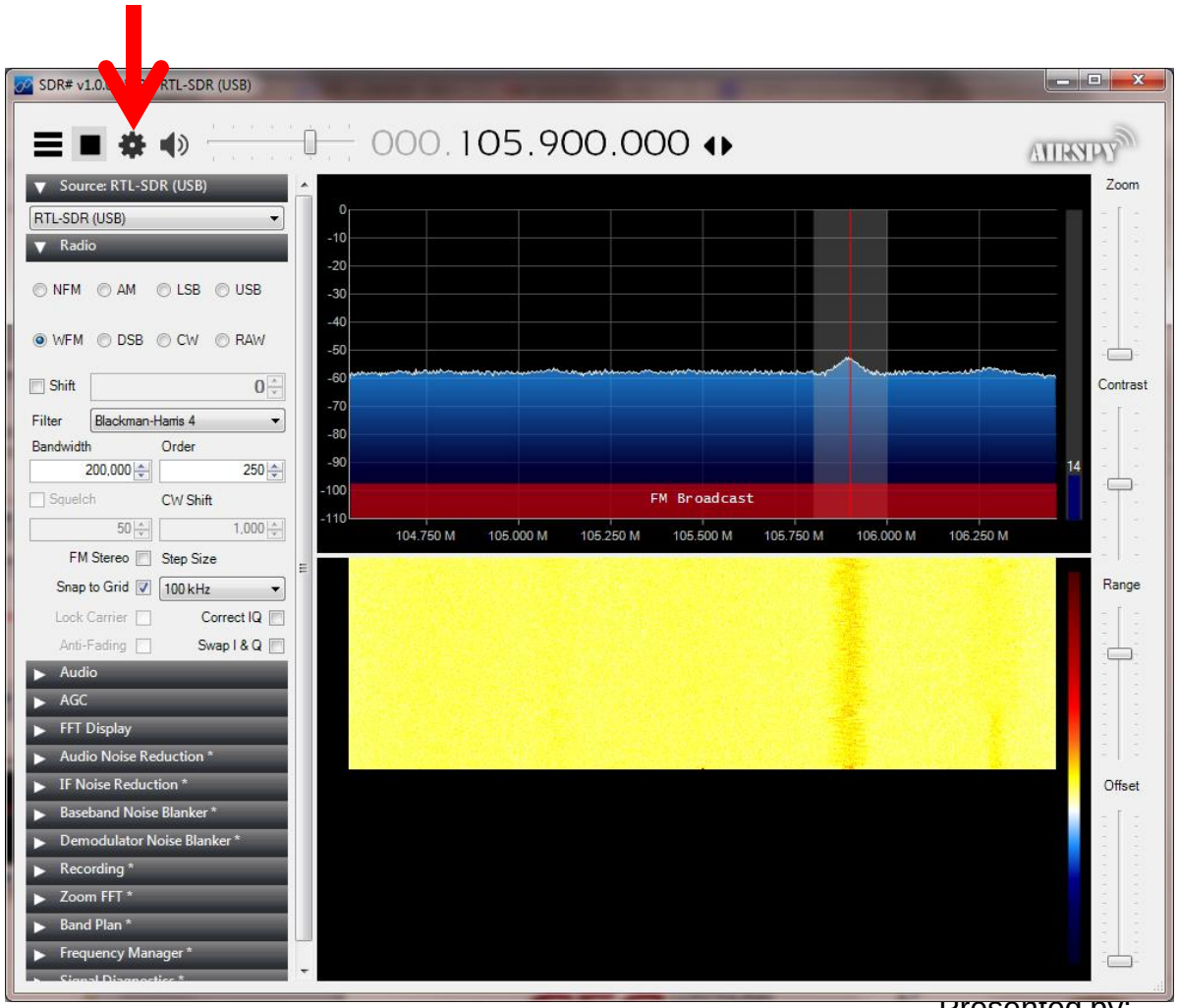
Noise!



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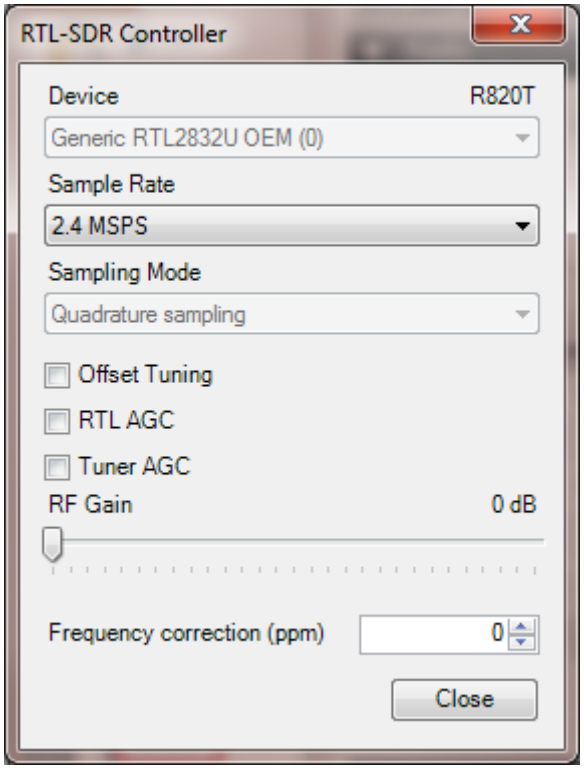
We need to either turn up RF or use AGC



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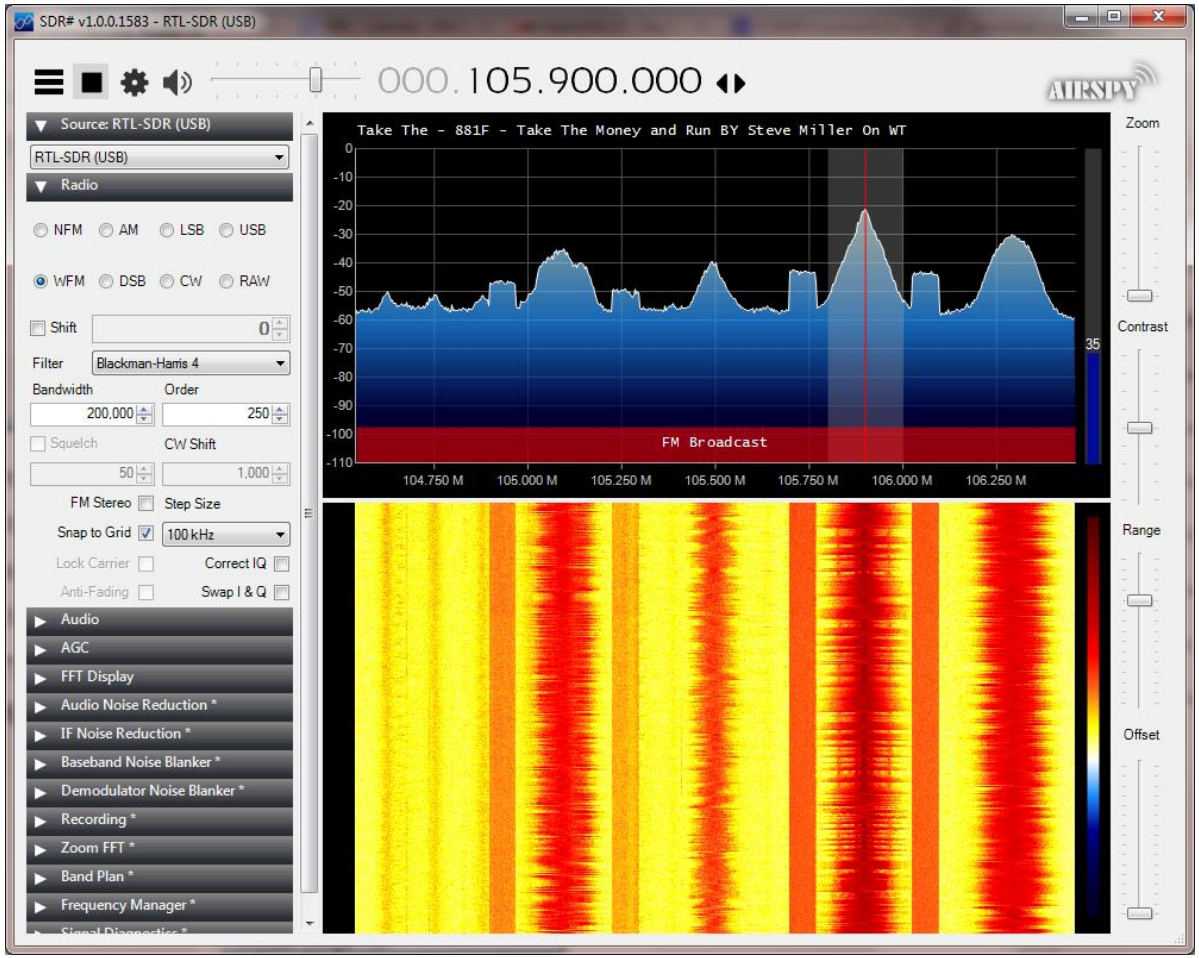
Now We are Rocking



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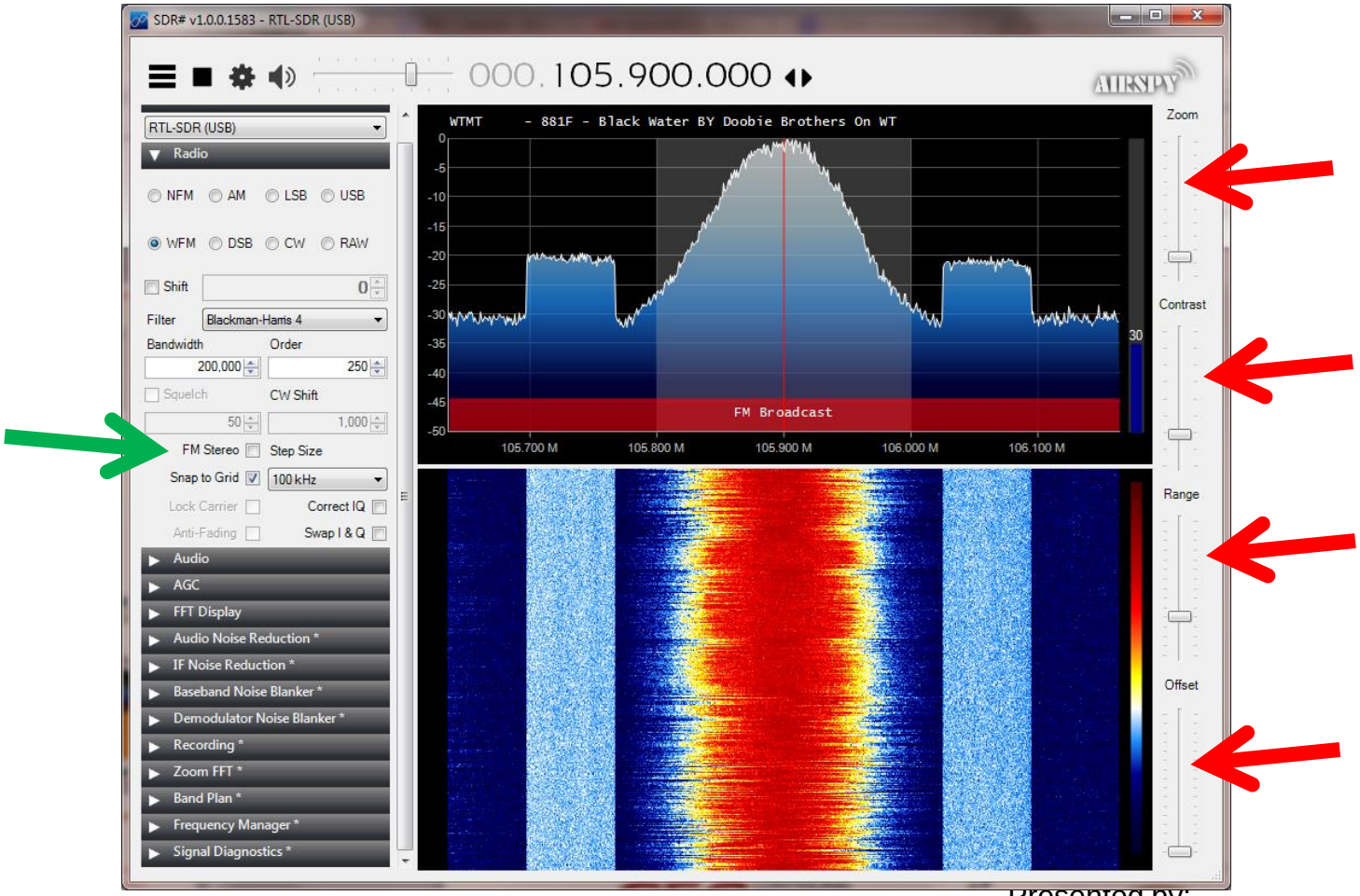
Play with these to get the signal centered and showing most info



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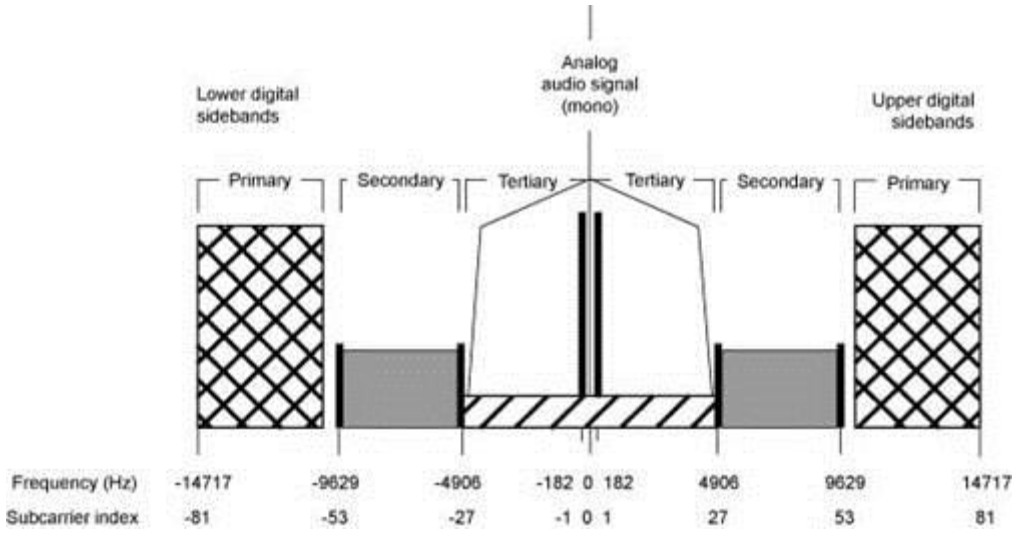
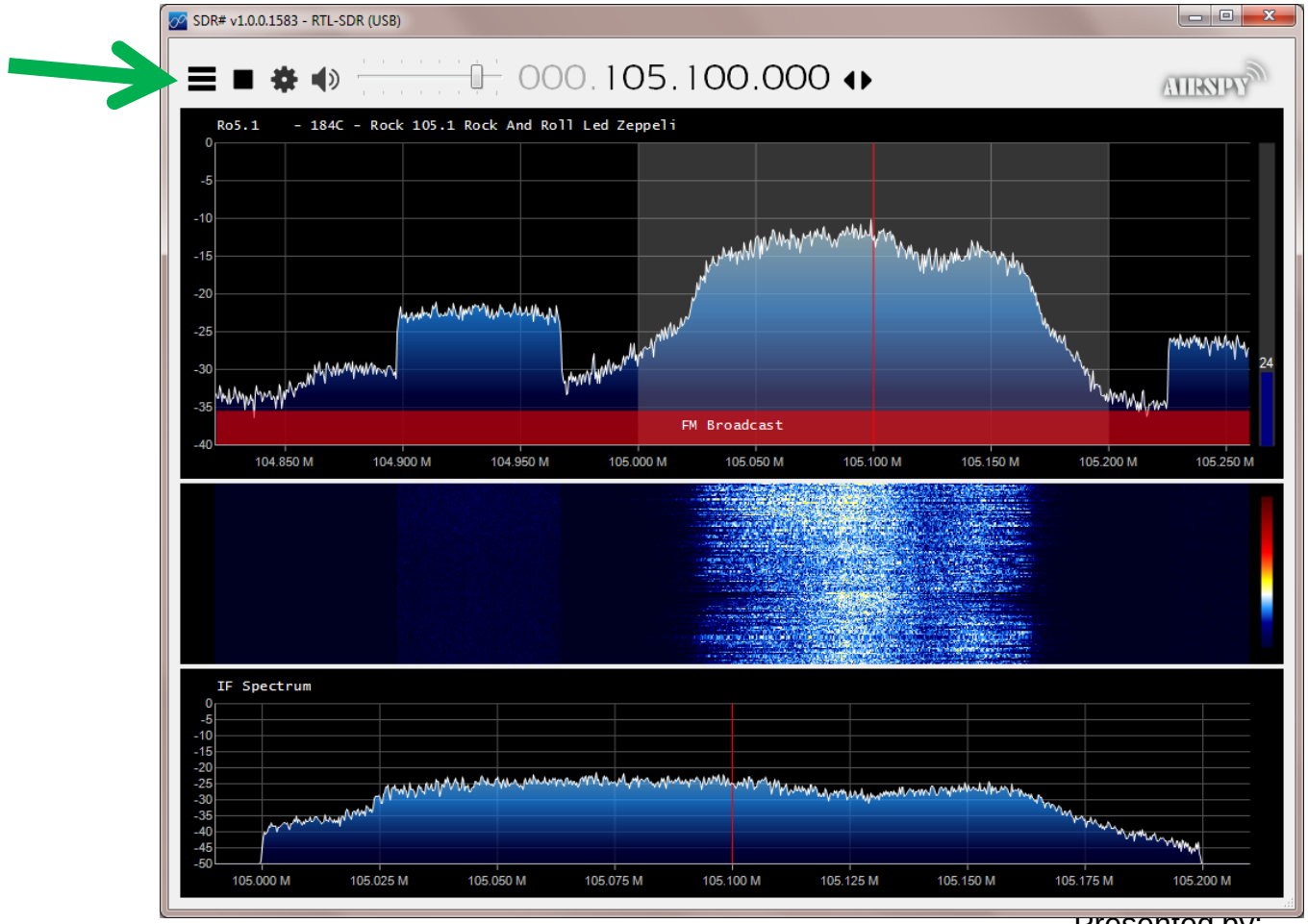
What are those huge sidebands?

FM HD or digital radio (Hybrid Analog / Digital)



Click on Menu to get full window



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Fine Tuning SDR#

- Increase the FFT resolution to at least 16384 (ideally 32768 or higher if your computer is powerful enough) under the “FFT Display” heading on the left menu to give yourself a clearer higher resolution spectrum and waterfall image.
- Enable the “Correct IQ” setting to remove the center spike
- Turn off the “Snap to grid” setting

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Challenges

- Look up the tower / approach / ATC frequencies for the local airport. Monitor (AM)
- Look for local amateur radio repeaters (NFM) http://www.artscipub.com/repeaters/
  - Find the squelch function to quiet the audio when the repeater is not in use.
- Place antenna next to an embedded processor board – look for harmonics and noise

Other Dongles

- Once you have these drivers installed, most other RTL-SDR devices should work. Try any that you have
- Due to the peculiarities of Windows, you may have to run zadig.exe again if you move the dongle to a different USB port on the computer

For Tomorrow

- Sign up for the free 30-day trial of Matlab and Simulink at *https://www.mathworks.com/programs/trials/trial_request.html*
- *Get the RTL-SDR support package from https://www.mathworks.com/hardware-support/rtl-sdr.html*
- *Under "Supported Hardware" download the free book and files*

Note

- If you will be using Matlab and have not installed it yet, you need to do so before tomorrow – it takes a long while!

Question 3 – Will you be doing the Matlab exercises?

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- Please give me a moment to scroll back through the chat window to find your questions
- I will stay on chat as long as it takes to answer!
- I am available to answer simple questions or to consult (or offer in-house training for your company)
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